RECHARGE….OUR AQUIFERS AND HOW DO THEY RECEIVE REPLENISHMENT?

by
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Once again the Texas Hill Country is in the grips of a serious, prolonged drought. Water levels are falling, wells are going dry and water use restrictions are in place. What are the important aspects of replenishing or recharging our aquifers? How do we get more water down into our aquifers? We will need to examine the following aspects of recharge:

1. Precipitation….how much, what kind and where
2. Bedrock……what kind of rock do we have
3. Soils ……what kind, how much.
4. Slopes…….…..how steep or flat is the land that is receiving precipitation
5. Vegetation……what kind, how much
6. Land use……..is the precipitation occurring on tilled agricultural land, pasture land, city streets, sidewalks, parking lots, etc.

The majority of the recharge is derived from the infiltration of precipitation on the areas where the limestone formations that contain the aquifers are exposed at the surface. Some recharge also occurs where streams flow across these same limestone units. Changing precipitation and stream flow to good useable recharge is one of the major aspects of management of our ground-water resources. So, how does recharge occur in our region?

First, let us start with precipitation. Rainfall in south-central Texas in a given storm can vary widely. We can receive 3 inches or more of rain in a very short time, or we can have a gentle rain storm that lasts for hours and spreads the precipitation out over a long time interval. We can have rain storms that are highly localized with very concentrated rainfall over a relatively small area, or we can have a rain storm that covers a large area, distributing water over that large area. If we have very intense rainfall or rainfall that is very highly concentrated over a small area, water may not have an opportunity to infiltrate into the ground and we lose the water to surface flow, bypassing our infiltration routes down into the aquifer. On the other hand, if we have slow, sustained rainfall, then we can receive appreciable infiltration.

Next, we need to examine the bedrock or where the limestone formations that contain the aquifers are exposed at the surface or are very near the surface. Most of our bedrock is limestone and limestone usually contains porosity (pore space) and hydraulic conductivity (the ability of a soil or rock to transmit water) but these properties can vary significantly. A tight, non-fractured limestone with little or no solution features such as caves, solution enlarged pores, etc., or with extensive beds of clay or marl is not going to be able to transmit very much water vertically downward from the surface to the water table. On the other hand, a highly fractured and /or faulted limestone unit with many solution features may be able to transmit very significant quantities of water downward.

Now for a look at the soil cover. If we have a good, reasonably thick soil cover (for example a sandy silty loam) the soils are going to be able to store some of the precipitation and prevent it from running off, thereby allowing the water to slowly infiltrate underground. If we have no soil cover, very thin or clay rich soils, the precipitation may run off as surface water and give us little or no opportunity for recharge.

Slopes in our region can vary from flat land to almost vertical cliffs. If the surface water from a rain storm is flowing rapidly down a steep hill side, it dos not have much opportunity to infiltrate into the soil or bedrock. On the other hand if we have gently sloping or flat areas, the surface water does not flow rapidly and there is a greater opportunity for the water to infiltrate downward towards the water table.

Vegetation can have an amazing effect on recharge. As precipitation occurs, it often first encounters vegetation. The rain may be caught and absorbed by the foliage and never reach the ground. Water which infiltrates underground may never reach the water table because of plant uptake through root systems. Vegetation such as grasses can also enhance recharge by retarding overland surface flow, thereby causing the velocity of water to slow and increasing the opportunities for the water to infiltrate into the subsurface. Plant roots can also improve the ability of a soil to intake water by providing pathways for vertical movement. What type of vegetation is present is important. Water infiltration is maximized when we have grass cover as compared to various shrubs. Several studies by Texas A & M Extension Service have shown that the presence of cedar (Ashe juniper) in the Hill Country will significantly decrease the amount of water in the soils, thereby significantly reducing recharge in these areas.

Land use is a variable that changes with time as an area undergoes suburban and urban development. We can appreciate that rain falling on a level, plowed field will have different recharge potential that rain falling on a rocky pasture. Both are agricultural uses but with different recharge potential. If we have suburban or urban development, we change the amount to impervious cover. Impervious cover is caused by streets, roofs, sidewalks, parking lots and other features that prevent precipitation from directly entering the subsurface. If we pave over an area, the precipitation that falls on that area either runs off as surface runoff or evaporates back to the atmosphere, neither of which will increase recharge except with very carefully engineered structures.

We have come a long way in understanding our groundwater resources since the Supreme Court of the State of Texas in a 1904 decision stated that the movement of groundwater was “so secret, occult, and concealed that an attempt to any set of legal rules [would result} in hopeless uncertainty and would therefore be practically impossible”. We know that one of the most important aspects of protecting our groundwater is intelligent management of these resources at the local level.