Executive Summary: Groundwater – Aquifer Recharge Project

In 2003, the Friends of the Teton River (FTR) initiated a unique groundwater-aquifer recharge demonstration project on a portion of the Fox Creek watershed, an important tributary of the Teton River, in the Teton Valley of Idaho. The project area extended between the western foot of the Teton Mountains on the east, to the eastern edge of the extensive wetland complexes along the Teton River on the west, and was bounded by Darby Creek on the north and extended a short distance south of Fox Creek on the south. The project was suggested because of increasing concerns about the condition of the alluvial aquifer beneath the valley and its importance for local water supply and for maintaining the viability of the local hydrologic regime and associated critical wetland and riparian habitats adjacent to the Teton River. Changing water use in the Teton Valley over the previous 40 years had acted to reduce rates of groundwater recharge, as irrigation methods switched from flood to sprinkler irrigation, and more recently as irrigated agricultural lands were converted to residential housing. The project sought to develop a detailed understanding of the surface water – groundwater interaction in the study area, to evaluate the significance of recharge from streams and irrigation activity on groundwater levels and spring discharge, and to identify practical considerations associated with recharge efforts that might be undertaken in the area in order to augment the local aquifer.

Six soil borings were drilled in the study area in 2003 to examine subsurface conditions in the area, and five of the borings were completed as shallow piezometers for groundwater level measurements. In addition to the five piezometers, 13 domestic supply wells located across the study area were selected for groundwater-level measurements, which started in the fall of 2003 and extended through most of 2004.

A recharge demonstration test site was selected where recharge efforts were maximized in order to induce as much groundwater infiltration as possible in a relatively limited area. In early 2004, FTR repaired existing irrigation infrastructure at the recharge site and installed a new concrete headgate in order to accurately measure and control the distribution of irrigation water. Irrigation water was continuously recharged over an area of approximately 35 acres at the demonstration site at varying rates averaging approximately 3 cubic feet per second (cfs) from early May through July 2004. Stream-flow measurements were also made throughout the season at several locations across the study area, including at a location immediately upstream of where Fox Creek exits the mountains, at the recharge demonstration site, at the foot of the Fox Creek alluvial fan, and on the spring-creek portion of Fox Creek immediately below the discharge point of the large Fox Creek spring complex. In addition, water diverted for irrigation purposes was quantified across the study area with the assistance of the Fox Creek Canal Company.

A geologic analysis, including a review of numerous well drilling logs from the area, allowed for a more detailed understanding of the subsurface geology of the area, which includes a westward-thickening wedge of relatively coarse grained alluvial fan deposits that grade into more clayey deposits beneath the lower elevation portions of the area.

These clayey deposits include thick clayey sequences, interbedded with thin beds of more permeable alluvium. Some of the clay layers are believed to be lake deposits associated with periodic damming of the northern portion of the Teton Valley by volcanic activity associated with the Snake River Plain and Yellowstone hotspot. The effect of this subsurface change from relatively highly permeable sands and gravels to relatively low permeability clays is to cause much of the westward flowing groundwater to emerge in a series of north-south oriented springs and seeps approximately 1.5-2.0 miles east of the Teton River. Alluvium thicknesses in the study area approach 1000 feet, and are underlain by up to several thousand feet of volcanics, which are in turn underlain by Mesozoic and Paleozoic sedimentary rocks that are exposed in the mountains to the east, west and south of the Teton Valley.

The field data collected during the course of the project was analyzed via groundwater modeling focused on the Fox Creek area derived from a previously developed regional groundwater model of Teton Valley, completed in 2003 in partnership with Nicklin Earth and Water of Bozeman, Montana. Recharge rates derived from the 2004 field data were assigned spatially and temporally across the study area. A trial-and-error model calibration was then conducted, which included modifying recharge rates and aquifer specific properties until the calibrated model provided a reasonable representation of the aquifer system stresses (i.e. recharge distribution). Following calibration, checks of model-simulated recharge rates were made to ensure that the modeled water balance was reasonably consistent with field observations, constrained by the available discharge in Fox Creek and the various irrigation ditches.

The recharge demonstration project and modeling results show that a clearly measurable positive effect on groundwater levels was induced by the concentrated recharge effort that utilized flood/sprinkler irrigation methods. The results of the study also show, however, that in the Fox Creek area there is little advantage to implementing widespread supplemental groundwater recharge except during the snowmelt runoff season when stream flow is high, as during periods of relatively lower flow, which is most of the year, any flow left in Fox Creek is lost completely via recharge through the bed of the stream channel. Even during the snowmelt-runoff season in 2004, much of the available flow in Fox Creek, as well that diverted from Fox Creek for local irrigation, either recharged the aquifer or was lost through evapotranspiration. Therefore, on an annual basis, most of the maximum amount of achievable groundwater recharge is already occurring in the study area. Further, the modeling showed that in 2004 most of the rise in the groundwater table that occurred in response to the peak period of recharge attenuated quickly, over a period of weeks rather than months, due to the high transmissivity of the aquifer in the eastern and central portions of the study area. These facts suggest that recharge efforts will produce only minor increases in groundwater levels in the lower elevation portions of the Fox Creek area late in the growing/irrigation season, and thus will likely have limited positive benefit for those seeking to use recharge to enhance sub-irrigation of lower elevation agricultural fields at that time. A similar difficulty will occur for those who seek to use groundwater recharge to significantly boost late summer discharge flows from groundwater springs in the Fox Creek area, as the effects of steepened groundwater gradients that result from recharge (and drive groundwater flow)

tend to rapidly attenuate.

On-going development and associated land fragmentation in the Fox Creek area is posing increasing logistical obstacles to implementing large-scale groundwater recharge efforts. This demographic change is also expected to lead to decreased irrigation from current levels, which will lead to decreased groundwater recharge over time. These changes will likely alter the local hydrology, possibly decreasing groundwater levels, flow from springs, and groundwater baseflow into Fox Creek area spring creeks and the Teton River. There is a potential positive side to these changes, however, as decreased irrigation demand may allow for higher in-stream flows during the high runoff period, which is a more natural hydrologic condition than that which exists at present due to irrigation diversion. Such a change should be beneficial to the native ecology, including a range of riparian zone plants, and fish species such as the native Yellowstone Cutthroat Trout, whose numbers have been greatly reduced in the Teton Valley.

The Friends of the Teton River are available for consultation with parties seeking to implement groundwater recharge efforts in Teton Valley.