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Gradient Self-Potential Logging in the Rio Grande to Identify Gaining and Losing Reaches across the Mesilla Valley

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ABSTRACT

The Rio Grande/Rio Bravo del Norte (hereinafter referred to as the "Rio Grande") is the primary source of recharge to the Mesilla Basin/Conejos-Medanos aquifer system in the Mesilla Valley of New Mexico and Texas. The Mesilla Basin aquifer system is the U.S. part of the Mesilla Basin/Conejos-Medanos aquifer system and is the primary source of water supply to several communities along the United States–Mexico border in and near the Mesilla Valley. Identifying the gaining and losing reaches of the Rio Grande in the Mesilla Valley is therefore critical for managing the quality and quantity of surface and groundwater resources available to stakeholders in the Mesilla Valley and downstream. A gradient self-potential (SP) logging survey was completed in the Rio Grande across the Mesilla Valley between 26 June and 2 July 2020, to identify reaches where surface-water gains and losses were occurring by interpreting an estimate of the streaming-potential component of the electrostatic field in the river, measured during bankfull flow. The survey, completed as part of the Transboundary Aquifer Assessment Program, began at Leasburg Dam in New Mexico near the northern terminus of the Mesilla Valley and ended ~72 km downstream at Canutillo, Texas. Electric potential data indicated a net losing condition for ~32 km between the Leasburg Dam and Mesilla Diversion Dam in New Mexico, with one ~200 m long reach showing an isolated saline-groundwater gaining condition. Downstream from the Mesilla Diversion Dam, electric-potential data indicated a neutral-to-mild gaining condition for 12 km that transitioned to a mild-to-moderate gaining condition between 12 and ~22 km downstream from the dam, before transitioning back to a losing condition along the remaining 18 km of the survey reach. The interpreted gaining and losing reaches are substantiated by potentiometric surface mapping completed in hydrostratigraphic units of the Mesilla Basin aquifer system between 2010 and 2011, and corroborated by surface-water temperature and conductivity logging and relative median streamflow gains and losses, quantified from stream-

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flow measurements made annually at 16 seepage-measurement stations along the survey reach between 1988 and 1998 and between 2004 and 2013. The gaining and losing reaches of the Rio Grande in the Mesilla Valley, interpreted from electric potential data, compare well with relative median streamflow gains and losses along the 72 km long survey reach.