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Comment on hess-2021-380

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Referee comment on "Advances in the hydraulic interpretation of water wells using flowmeter logs" by Jesús Díaz-Curiel et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-380-RC2, 2021

The author's response to my rather cursory review (as per the request for quick turn-around) has been responded to with a note that much of the earlier work on using flowmeter profiles to quantify hydraulic head differences in aquifer layers relates to aquifer tests made at low pumping rate in low-capacity wells. Actually, these flowmeters can be adapted to measure substantial flow rates in some cases. The general method is applicable to stratified granular aquifers, and has been used in that application, even in most of the referenced works were for fractured bedrock or karst. The generalized method has already been described as applicable to any pair of quasi-steady flow conditions, which could be static and pumped, a pair of pumped conditions or even injection. Some authors have extended that to consider several such states, and then fit the flow model to the profiles. The general scheme is the same: measure flow under two conditions to get two sets of inflow/outflow data, and then "invert" the model fit to solve for transmissivity and head simultaneously. In general, this is like solving any set of coupled equations for two variables. If more than two data sets, the problem is treated as a standard over-determined inversion.

That said, the technique has not been applied to impeller flowmeter logs and that has real practical applications. Other flowmeter work has demonstrated that the technique works effectively within screened wells. The analysis gives relative head difference between quasi steady open hole water level during pumping and the far-field head in each producing zone. But that can be converted to actual head by reference to the static water level if known. But keep in mind that the corrections to inferred interval transmissivity still involve skin and turbulent inflow contributions, negligible at ultra-low pumping rates. But a more important point is that the transmissivity value applies to the immediate vicinity of well bore or screen. This is imposed by the convergent flow regime. Large-scale aquifer properties are, however, indicated by the hydraulic head estimates. This application is especially relevant in contamination studies where one wants to know if one contaminated aquifer is isolated from another.

In summary, the authors have added a note that the idea of inferring hydraulic head in situ in multi-level aquifers (both fractured bedrock and granular sedimentary layers) has been around for a while, but almost none of this has been worked out for impeller flowmeters in high-discharge wells. Hence their manuscript provides new results. Even

more interest could be added by addressing the specific complications produced under such well test conditions. But even more relevance can be added by citing the need to understand the large-scale structure of aquifers concerning recharge and contaminant communication rather than just a correction to standard ump test evaluations of transmissivity based on the assumption of a single aquifer. The ability to infer head differences in situ for multi-level aquifers has a lot more application than just correcting measured transmissivity for the presence of those head differences.