

MPD Ksat RMS Error (Explained)

Root Mean Square

Upstream Technologies MPD server reports the RMS error for each MPD test performed. These values can help determine the validity of each Ksat calculation reported.

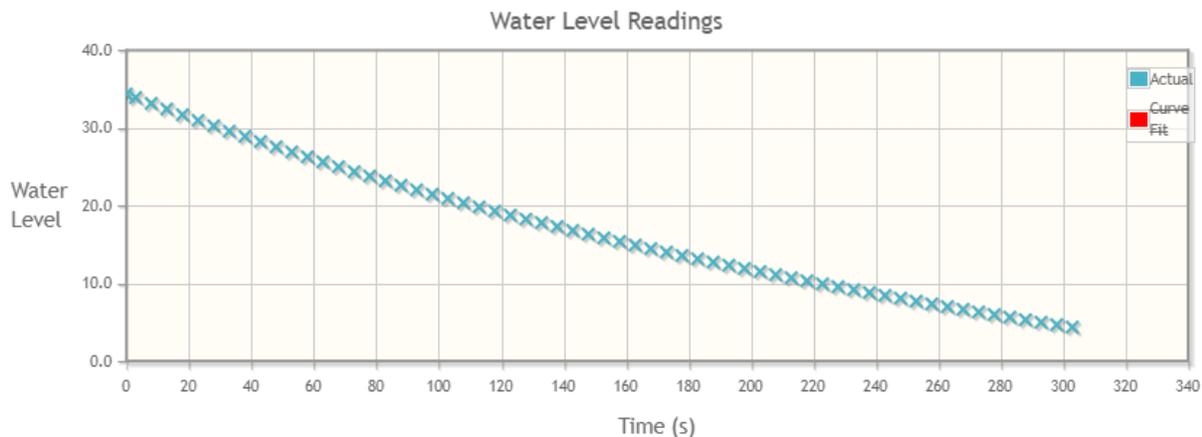
RMS is reported 2 ways:

- RMS Error of regression (in seconds)
- Normalized RMS Error (as a percent)

This RMS error is a measure of the optimization routine (iterative calculation) that determines field hydraulic conductivity (Ksat) and soil suction (C). Following are the steps required to calculate Ksat and C from the field data and how RMS is calculated:

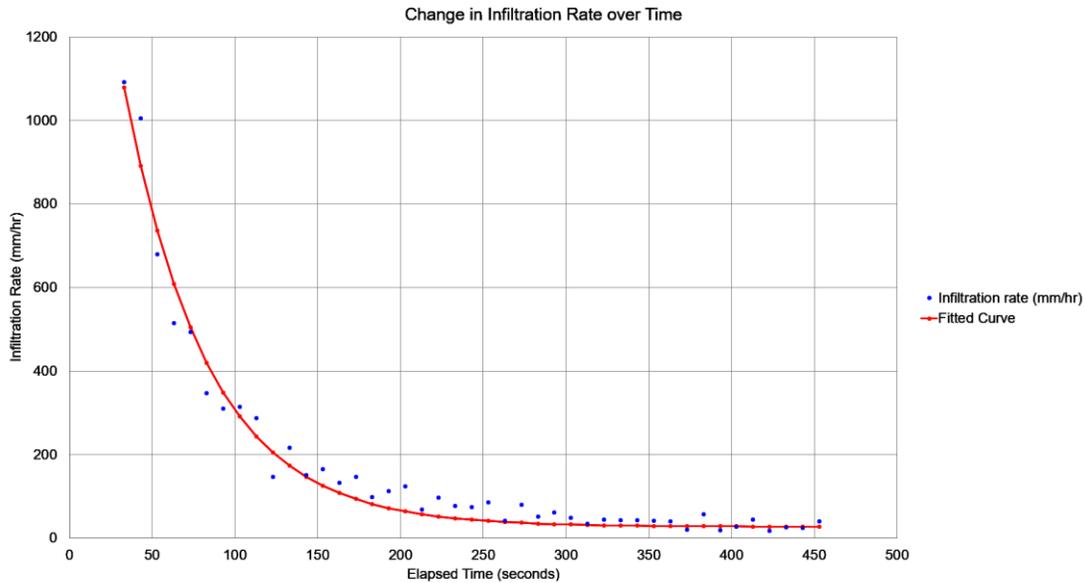
Step 1: Raw Field Data

The raw data gathered in the field consists of water level (H, in mm) versus time (t, in seconds). Plotted, it looks like this:



Step 2: Infiltration Rate vs. Time

The next step is to calculate infiltration rate for each set of two subsequent data points from the raw field data. Each infiltration rate calculated is then plotted against time. See figure below.

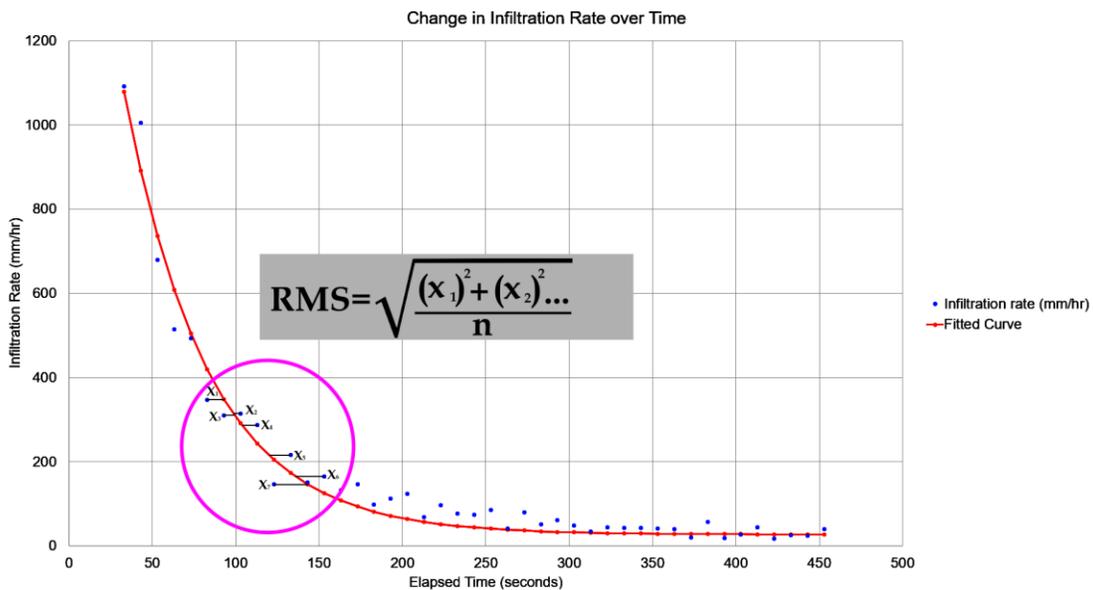


Step 3: Fit a Curve

An exponential decay curve is fitted through these data points (red line in figure above).

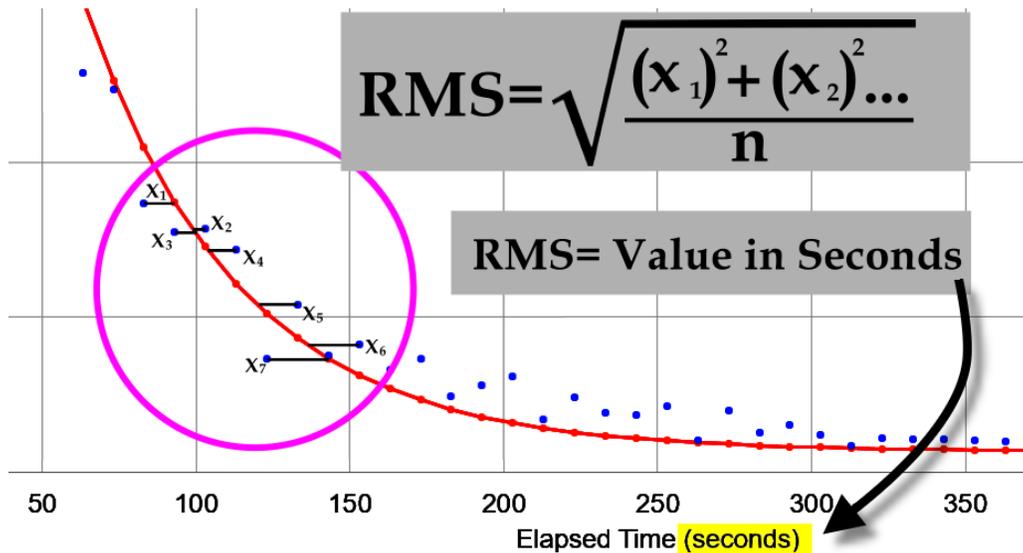
Step 4: Difference Between Raw Data and Fitted Curve

For each infiltration rate calculated from the raw data, the distance (in seconds) is recorded between the actual infiltration rate, and the fitted curve, as shown below. Call each of these distances x_1, x_2, \dots, x_n . This is the scatter or noise found in the data.



Step 5: Calculate RMS Error

Square each “x” value calculated in Step 4. Add all these together. Divide by the total number of data points, then take the square root. This is the RMS error for the MPD test.



The RMS Error of Regression is reported in “seconds”, as it represents the difference between the measured elapsed time and the fitted curve elapsed time.

A low RMS error demonstrates a more reliable calculation of Ksat. RMS represents the amount of noise or scatter of the plotted infiltration rates against the fitted curve.

HOWEVER, RMS Error will always be larger with longer tests.

As the length of a test increases, the RMS error also increases, making it difficult to compare RMS from test to test. Normalized RMS is therefore needed.

Step 6: Calculate Normalized RMS

Normalized RMS is calculated by dividing RMS Error (by) the length of the test (Last infiltration rate time (minus) First infiltration rate time)

Normalized RMS is reported as a percent %. **Normalized RMS = $\frac{\text{RMS}}{\text{Time (last) - Time (first)}}$**

Rule of thumb: Ksat Calculations with a Normalized RMS:

- Under 5% is Excellent
- Under 10% is Very Good.
- Under 20% is OK.