# Monitoring Landslides and Groundwater Levels in Jeffersonville, Vermont.

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## Introduction

The last major landslide at Deer Run Heights in Jeffersonville, Vermont area occurred in 1999 and was very close to taking out local businesses as well as houses in the area. This has led to land farther down the river to be monitored, for it is now unstable. If this area of land were to become too active and form a landslide, it would take out houses that are located up on the ridge itself, and could even possibly pose a threat to the local elementary school. There are many factors that go into the cause of landslides, but the main focus here is the groundwater level, for that is a contributing factor in landslides especially in this highly saturated area. This area's saturated earth has to do with it's geography and the rivers that surround Deer Run Heights.

## Methods

During the duration of data collecting of the landslide taking place in Jeffersonville Vermont, known as the Deer Run Heights Landslide, several technological tools were used to produce interpretable data. These tools specifically being but not limited to, Silva Ranger Compass, Garmin eTrex GPS, the HOBO U20 water level data loggers, pressure-based water level data loggers that measure and also record water level data and stores this information for later retrieval. Another device used was the Solinst Water Level Meter, which purpose was to measure if there was water in the wells, and at what height the water was, and a metric measuring tape. In addition to these tools, a device known as the Time Domain Reflectometry device (TDR) proved to have an utmost contribution to our data collection. The TDR system helps prove and record landslide occurrences.

To calculate data from the Deer Run Heights Landslide, several wells were drilled, showed in figure one, that are used to collect water level information and land slippage. The Time Domain Reflectometry system answers questions such as; is the land moving? Where is it moving? How fast is it moving? "In TDR, a cable tester sends a voltage pulse waveform down a cable tester in a drilled in well. If the pulse encounters a change in the characteristic Impedance of the cable, it is reflected. This can be caused by a crimp, a kink, the presence of water, or a break in the cable. The cable tester compares the returned pulse with the emitted pulse, and determines the reflection coefficient of the cable at that point" (Kane, 2000).

Other methods for measuring land movement include using rebar stakes. This method involved measuring the edge of the ridge to the stake, recording said data, then measuring at a later time to see if the distance decreased thus indicating dangerous land movement. The Solinst Water Level Meter was used for collecting data of the monitoring wells. These well were drilled for the purpose of testing the water level. "A water depth instrument, model 101 by Solinst, is used to monitor the water level in each well. A sensor attached to a tape measure is run down the PVC pipe until a beeping sound can be heard from the unit" (Banks 2009). The figure to the direct right shows the tool that was used in the data collection of the monitoring wells of the landslide.
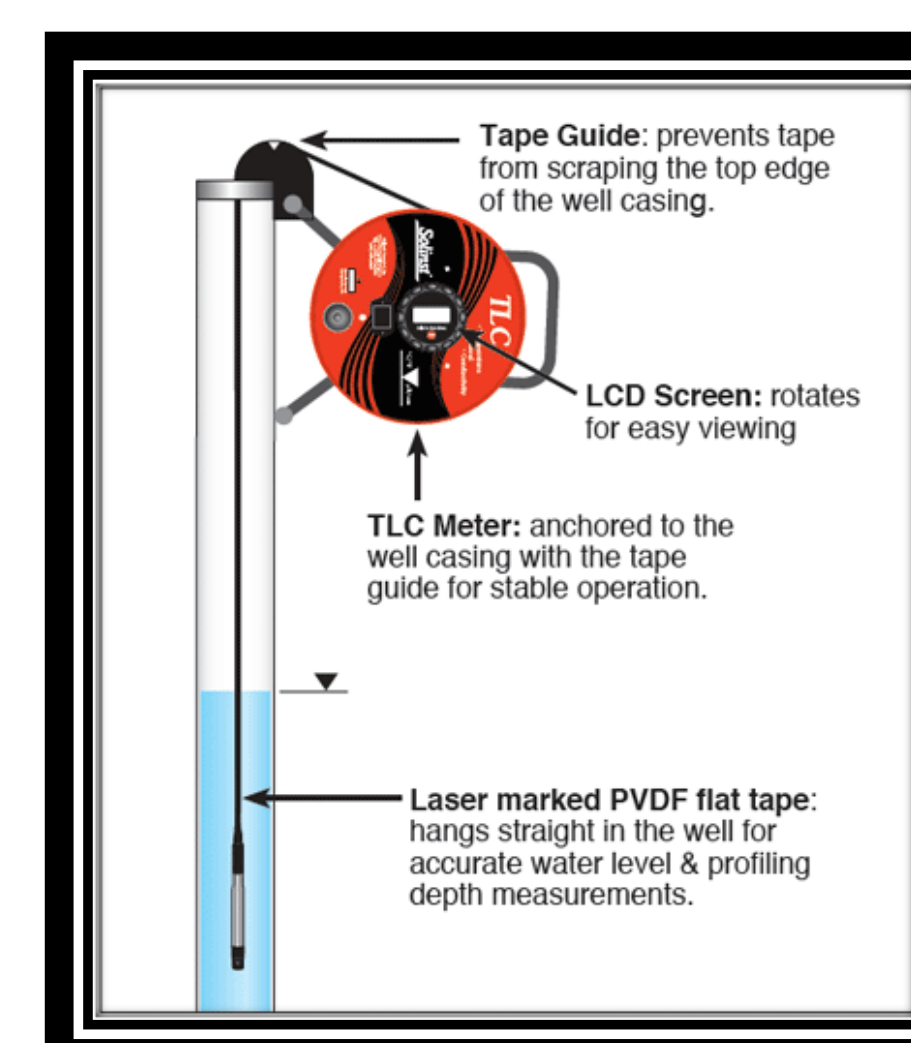
## Graphs & Photos
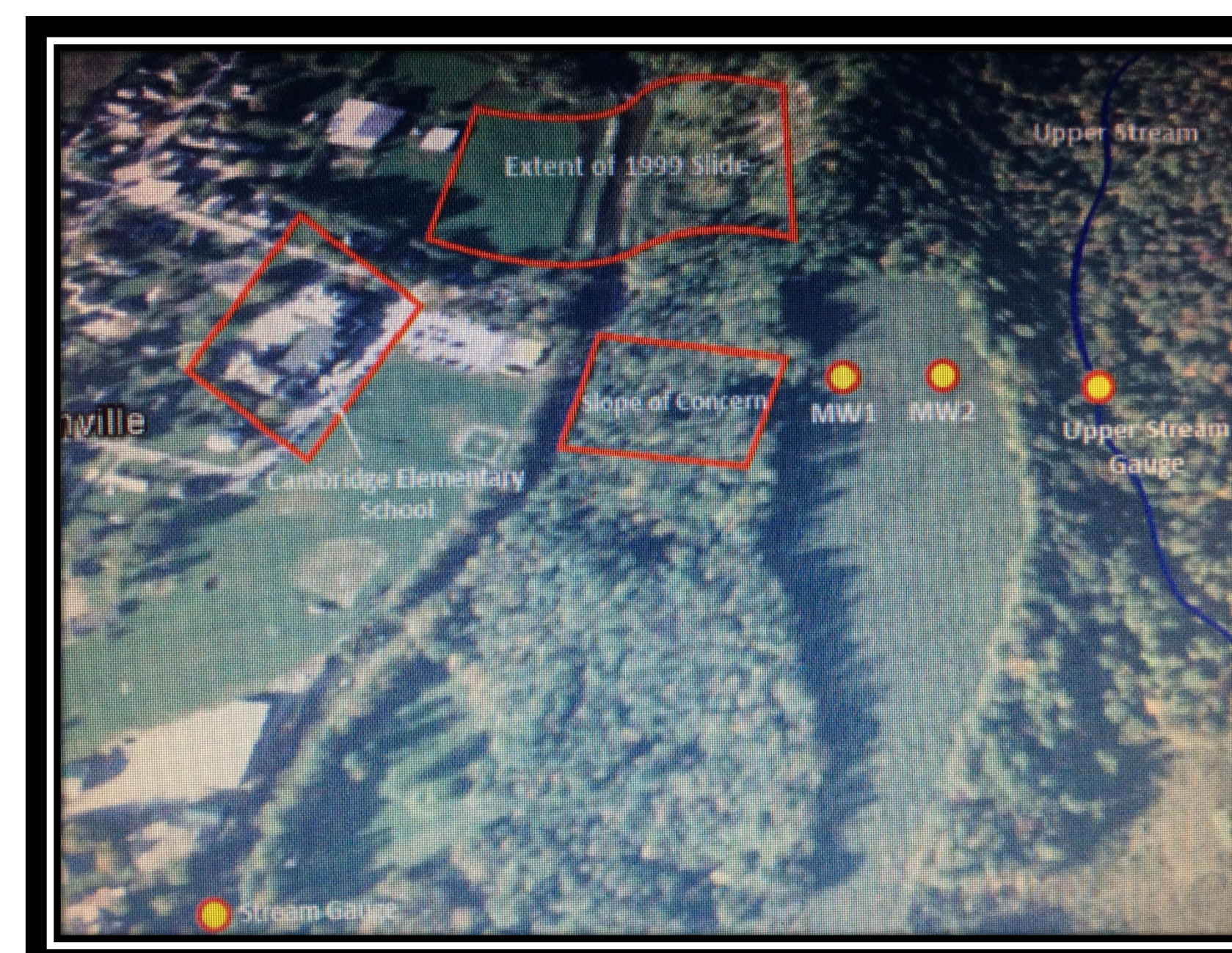


Map of Region (Post 1999 Landslide)
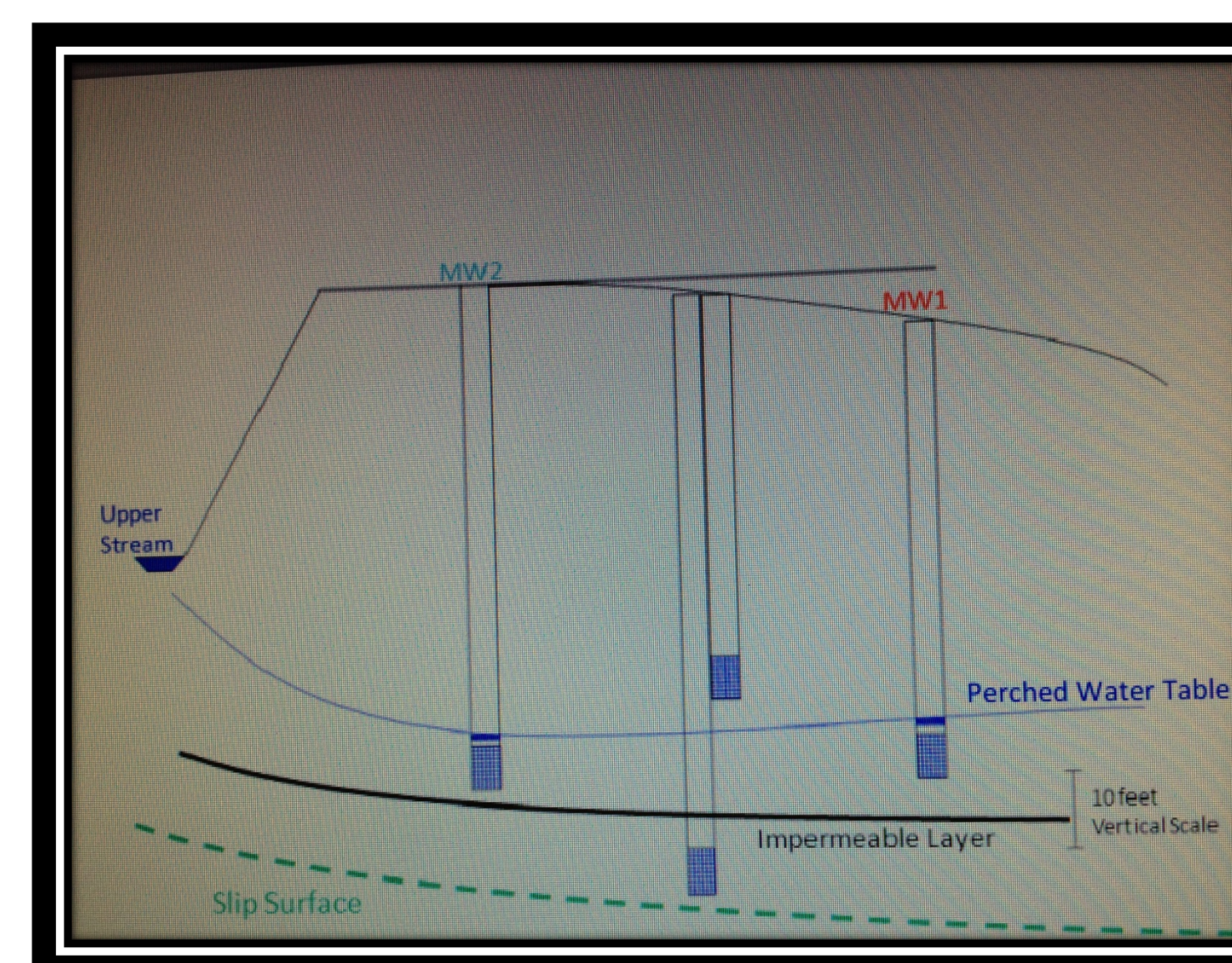


Perched Water Table Including Both
Wells Used With HOBO & Solinst
Data Retreivers



Solinst Water Level Meter

## Results, Data Analysis, and Discussion

Although a landslide could very well happen in Deer Run Heights if the conditions were right or a major storm occurred, it can be perceived that a landslide won't occur in this area in the close future due to the lack of high groundwater levels in the area and other such key factors which contribute to landslides. A landslide may not happen this exact moment in Jeffersonville, Vermont but it could definitely be a threat later on down the road. The reason that this can be said is because the one main factor that is needed for a landslide, water, is not sufficiently present in the area. The soil in Deer Run Heights is one that is easily affected by water because once the water starts building up on the perched water table, it weighs down the top layers of sand and it then becomes unstable.

With the use of the HOBO data logger and the TDR it is seen that there is a lack of said water and land movement. The data loggers showed that no water from the Upper Stream has been leaking into the ground up at Deer Run Heights and saturating the land. It also shows that there has not been enough rainwater for it to start sufficiently adding up above the perched water table. It can also be seen with the TDR that now no large amount of ground movement is happening at Deer Run Heights. It can be concluded with this information that there is a lack of an excess of water in the area, so the ground has been allowed to remain stable for the time being. All in all one can presume that the ridge at Deer Run Heights is only moving slightly downhill due to it's steepness, but one has to wonder when the next big storm will hit Jeffersonville, Vermont, and if this will add enough water above the perched water table to cause another catastrophic landslide up at Deer Run Heights

## References

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## Acknowledgements