

BICA 2011 Continuous Monitoring Pilot Project Summary

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Summary

This document summarizes the initiation of a monitoring project on continuous discharge data collection for 3 springs and one stream in Big Horn Canyon National Recreation Area (BICA) in 2011. This document was preceded by a document titled "BICA 2011 Well and Level Logger Install Summary" delivered on September 8th, 2011.

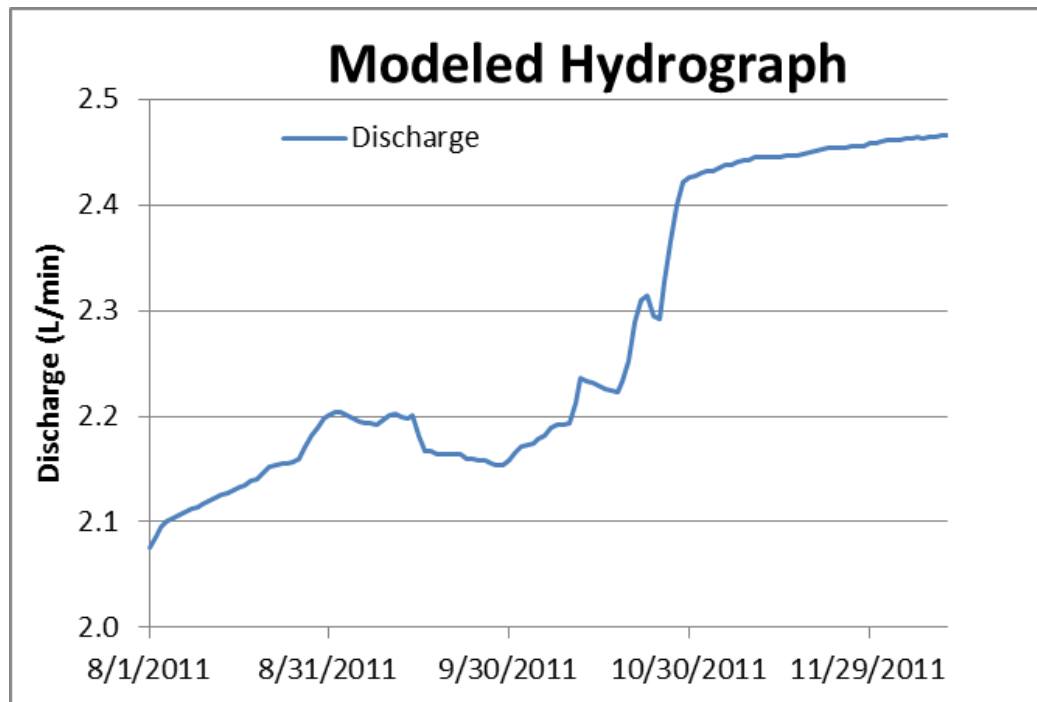
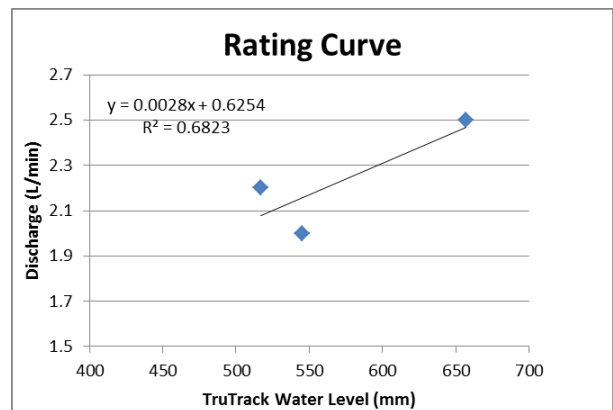
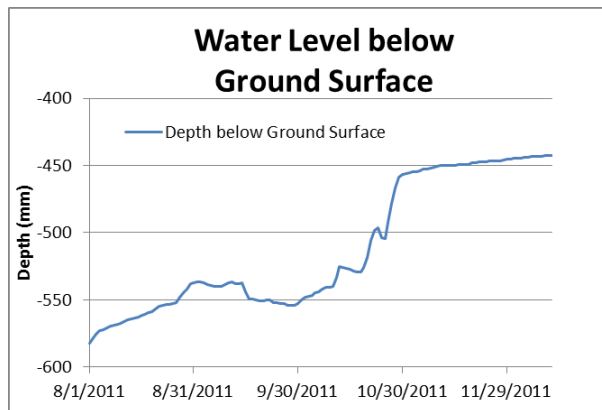
In March of 2011, MSU Extension Water Quality (MSUEWQ) inquired with Cassity Bromley, the Chief of Resources at BICA about installing continuous stage recorders on Layout Spring near the source (LayoutSpr1) and at the lower Layout site below the main park road (LCR2). This work was based on curiosity on the part of MSUEWQ and was performed without compensation and with donated MSUEWQ equipment. Subsequently, in the summer of 2011 the GRYN amended a task agreement with MSUEWQ to refine the continuous monitoring at the two sites on Layout Creek, to add a pressure transducer at the orifice at the LayoutSpr1 site and to install shallow wells and continuous stage recorders at Mason-Lovell and Lockhart Stockpond Springs. Installation of shallow wells and data loggers on August 2nd occurred shortly after funding was put in place and before equipment could be ordered, so MSUEWQ loaner equipment was used at LayoutSpr1, LCR2, Mason-Lovell and Lockhart Stockpond until the end of the 2011 calendar. On the routine December sampling trip, the loggers were traded out for TruTracks purchased by MSUEWQ for the NPS. Due to a transfer of equipment between projects, the TruTrack data for LayoutSpr1 and LCR2 between September and December were inadvertently lost but pressure transducer data are available for that period. The pressure transducer in the orifice at LayoutSpr1 was installed on September 30th 2011.

Initial data collected during 2011 provided an opportunity to refine methods and to conduct an initial assessment of potential effectiveness of monitoring water levels to model continuous discharge at BICA springs. The Layout sites which showed significant changes in discharge over the March to December period should be well suited for continuous discharge data collection. Discharge in Mason-Lovell and Lockhart Stockpond did not show large changes in water level or discharge during the August to December period which makes building stage/discharge relationships tenuous. So it will be necessary to continue monitoring in 2012 to determine whether groundwater levels and discharge will vary sufficiently to create model relationships between the two variables at these sites. While a lack of change in water levels at the springs would preclude rating curve development, the continuous water level data still provide useful insight about the stability of water flow from the springs with current climate conditions, which could change in the future.

Mason Lovell Spring

During the 3 month measurement period in the fall of 2011, the measured groundwater level in Mason Lovell spring varied by approximately 15 cm and the discharge varied from 1.9 and 2.5 liters per minute. While there was relatively modest variability of groundwater level and discharge over this period the overall relationship between depth to groundwater and discharge provides a relationship suggesting that it may be possible to model continuous discharge using water depth at the site.

The 2.2 L/min discharge measurement was made on the same day the well was installed (8/1/2011). It is possible that the well had not come into equilibrium with the surrounding water table and that the 2 L/min measurement made on September 30th was more representative. If this is the case, the long term rating curve could produce a stronger R^2 value.

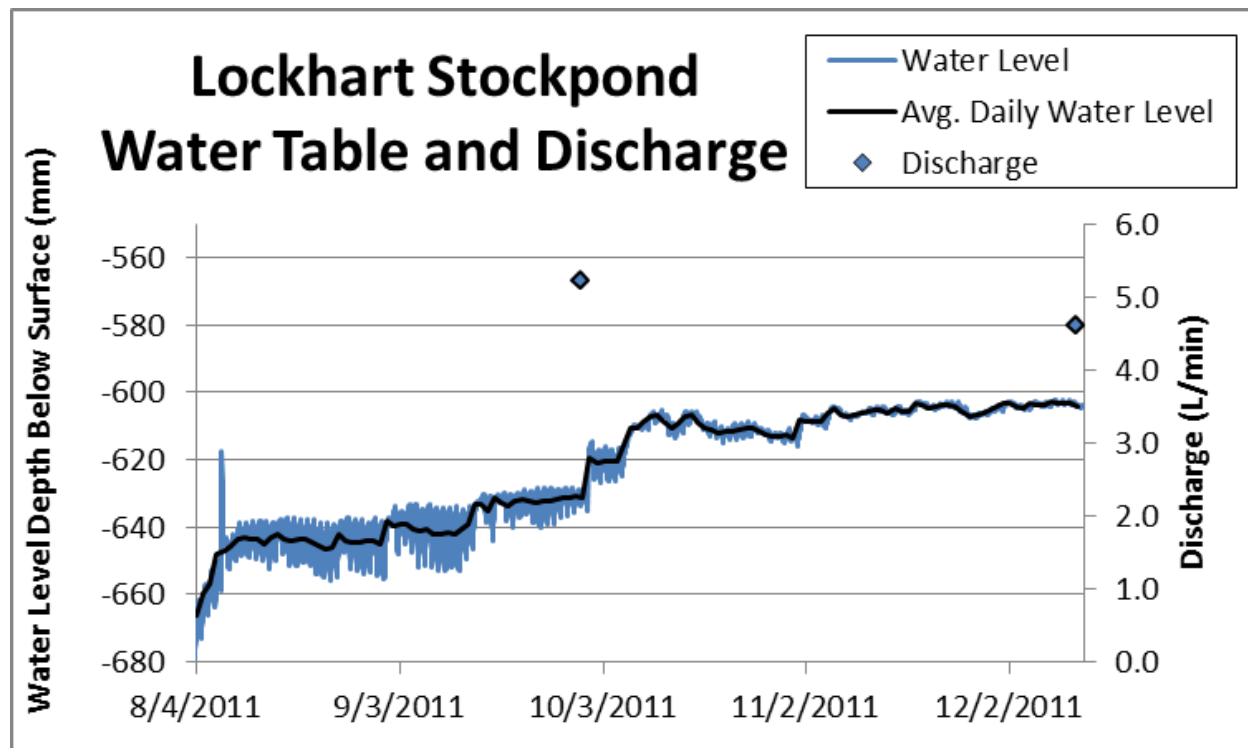


Lockhart Stockpond

During the 3 month measurement period in the fall of 2011, the measured groundwater level in Lockhart Stockpond spring varied by less than 7 cm and the height of water in the weir (method for measuring discharge) varied by only 1 mm. The relationship between groundwater height and discharge for these two points produces a negative relationship which is counter intuitive and suggests that measurement error overwhelms the modest variation in discharge for this data collection period.

In accordance with stream monitoring SOPs, the weir is removed between measurements and reinstalled to measure discharge on each visit. The purpose of removing the weir is aesthetic at most sites but cattle access to the orifice at Lockhart Stockpond spring was an additional reason for removing the weir at this site in the past. A fence installed around the spring in 2011 should exclude cattle and it may be possible to leave the weir in place between measurements to develop a rating curve. This could improve the rating curve but freezing in the winter might heave the weir and require repositioning.

Continued monitoring in 2012 will be necessary to determine whether it is feasible to model discharge from water level at this site. The following graph presents the Trutrack data and discharge measured from weir water height. The blue line is all Trutrack measurements (points collected while instrument was being downloaded are removed).



Layout Spring and Creek

All Trutrack data for both Layout Creek sites are provided in this graph for assessment of the larger Layout system response. The Trutrack rating curves for these two sites are reasonably good (upper site $R^2 = 0.98$, lower site $R^2 = 0.94$) and have 4 measurement points which makes them fairly reliable. At the upper site, the Trutrack and the pressure transducer are intended to serve the same task. There are only 2 calibration points for the pressure transducer rating curve which is not enough to know what the shape of the rating curve should look like, so a linear fit line was used. The two points do suggest that depth of water in the orifice may be a useful proxy for modeling discharge. In 2011 the data collection periods for the Upper Trutrack and the pressure transducer did not overlap but in 2012, comparison of results from both methods will allow for an informed decision on which is more effective. One limitation of the pressure logger without an accompanying barometric logger is a reliance on pressure data from nearby weather stations which is time consuming to collect and are not a perfect representation of barometric pressure at the site. If the pressure transducer is selected as the preferred method, a baro logger should be installed at the site.

