SOUTH BAY

IMPLICATIONS OF THE DRAINING OF MILL POND

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Introduction

Mill Pond is located to the east of a topographic divide on the mill site. It receives surface runoff and shallow groundwater discharge. At the northeastern/ eastern part a small dam has been constructed.

The surface elevation of the water level in Mill Pond is such, that it is higher than the elevation of the seeps WHS and WHSS. Mill Pond could, therefore, be a source of water contributing to these seeps. Unfortunately, there is neither shallow stratigraphic information nor information with respect to the configuration of the bedrock surface between Mill Pond and the seeps to indicate a potential path for the shallow groundwater. Furthermore, it would be next to impossible to obtain this information, because of the effect of the decommissioning and subsequent landscaping of the mill site.

The only way to determine a possible inter-relationship between the seeps and Mill Pond is to drain the pond temporarily and observe the effect of the draining. The experiment was started on June 3, 1998, after a siphon, which drains towards Boomerang Lake, had been installed in the Mill Pond. Daily and on occasion multiple daily measurements were taken of the flow at various locations on the mine site, the water levels in piezometers, shaft, PRC, etc. Furthermore precipitation was recorded, as well as basic chemical parameters were measured and water samples were collected for future analysis.

Draining of Mill Pond

Figure 1 shows the response of the flow at WHS & WHSS and the elevation of the groundwater level at various points on the Mine Site during the lowering of the water level in Mill Pond. This figure clearly illustrates, that:

1. The flow at seeps WHS & WHSS is immediately affected by a drop in the elevation of Mill Pond. The seep WHSS stopped flowing after lowering the water level in Mill Pond 1.25m. At this point in time the flow at seep WHS had decreased by 43 %. The flow at this latter seep continued to decrease and at the end of the measuring period (July 4, 1998), the flow had decreased by 71%.

2. The elevation of the water level in piezometers M13, M38 and M57 declines significantly and follows the trend of the water level in Mill Pond.

3. The change in the elevation of the water level versus time in piezometers M14, M15 & M18 and the PRC & Shaft is similar and declines gradually and marginally.

Figure 2 shows the drop in the elevation of the water level at the various measuring points on the Mill Site over the period June 3 – July 4, 1998. Figure 3 illustrates the drop in the elevation of the water levels over a similar period (June 4 – July 1, 1998) in a number of piezometers located west-southwest of the Tailings Basin and northwest of the Mine Site. This latter figure shows the regional trend in the behavior of the water levels and is unaffected by the draining of Mill Pond.

A comparison of Figures 2 and 3 shows beyond doubt that the behavior of the water levels in piezometers M15 & M18 and the PRC & Shaft follows the regional trend and is also similar with respect to the magnitude of the change. In other words, the draining of Mill Pond did not affect the hydraulic head at these measuring points. Piezometers M13, M38, M57 and to a much lesser extent M14 show a behavior different from the regional trend and were obviously affected by the draining of Mill Pond.

Effect of Precipitation during the draining of Mill Pond.

During the period June 3 – July 4, 1998 a number of fairly significant precipitation events occurred. Figure 4 shows the elevation of the water level in Mill Pond, the flow rate of the siphon draining Mill Pond and the amount of precipitation. This figure clearly shows that the rate and continuity of the flow at the siphon primarily control the water level in Mill Pond during the draining. Even a 30mm rain event at 603 hours does not appear to affect the water level in the Mill Pond.

Figure 5 shows the elevation of the water level in piezometers M13, M38 & M57 and the precipitation. This figure illustrates that M38 is not affected by precipitation and its trend is primarily controlled by the water level in Mill Pond, as was pointed out before. Both M13 & M57 show trends similar to M38 up to about 400 hours into the draining experiment, but the former two piezometers show a gentle increase from about 400-700 hours. This interval corresponds to the time period where the siphon was only operating intermittently. On the other hand, it could also reflect the effect of delayed storage, as a result of precipitation events, in the waste rock piles immediately adjacent to the piezometers or may be the result of both delayed storage and the intermittent operation of the siphon.

Figure 6 shows the elevation of the water level in the PRC, Shaft, piezometers M15 & M18 and the precipitation. As can be seen in this figure there is no immediate response of the water levels to precipitation events, except possibly in M18, which does show some slight increases in the elevation of the water level over the time period from about 250-350 hours and around 600 hours, which corresponds with precipitation events.

The flow measured at WHS, WHSS, BRC & BR2.5 and the precipitation is shown in Figure 7. This figure illustrates that BR2.5 shows an immediate and relatively strong response, WHS a muted response and BRC no response to precipitation. WHSS did not show any response after it had quit flowing.

General Observations

The area enclosed by a line from M38 – M14 - M15 – M57 – M13 – Shaft – M38 was a topographic low area prior to mine construction. During construction large volumes of fill (waste rock) were placed in this area, especially in the northwestern part of the topographic low area, which resulted in the creation of topographic high areas. These topographic high areas act as recharge areas for M13 & M57 and Mill Pond. Although these piezometers were drilled almost for their entire length in bedrock, the permeability of the weathered bedrock was sufficient, that an obvious connection existed between the piezometers and the topographically high waste rock piles. Once the waste rock piles were being de-watered by the draining of Mill Pond, the water levels in piezometers M13 & M57 showed an immediate response and drop. It is conceivable, but unlikely, that both piezometers (although drilled in bedrock) may be located immediately next to a “Kalin Canyon” type structures, which run under Mill Pond. Such a setting could then also explain why a drop in the water level of Mill Pond would result in a drop of the water levels in these piezometers. To determine if this type of subsurface structure exist, geophysical surveys have been conducted in this area during the Fall of 1998.

Piezometer M38 also showed a rapid response to the draining of Mill Pond, which indicates a direct hydraulic connection. This piezometer is located, based on the pre-construction topographic map, at the southwestern end of a saddle between the topographic low area described above and the start of a drainage channel towards Confederation Lake. (NOTE: this channel was subsequently infilled with waste rock during mine construction). It is not known, if the saddle separating the depressions is a bedrock high or not. According to Morton, 1987, 5.6 m (18.5 ft) of fill was encountered during drilling of the piezometer. However, based on the original topographic map the surface elevation at M38 is approximately 425.96 m (1397.5 ft), while the current surface elevation is 423. O44 m. In other words, the area appears to be excavated rather than infilled. If this contention is true, than the saddle in all likelihood is not a bedrock high and may very well be a sediment infill in an existing bedrock channel. If bedrock closure exists between Mill Pond and the major topographic depression, which runs in a northeasterly direction towards Boomerang Lake, than a direct subsurface pathway may be present between Mill Pond and Confederation Lake. i.e. the potential of contaminant movement.

The seep at WHSS appears to have been fed entirely by Mill Pond and the pathway from Mill Pond to WHSS occurs at relatively shallow depth. Major precipitation events, which occurred after flow had ceased (i.e. a drop of 1.25m in the water level of Mill Pond), did not re-initialize flow. It appears, therefore, that the configuration of the bedrock surface is such, that precipitation falling in the surface catchment area is directed away from the seep and most likely towards Mill Pond.

The seep at WHS appears to have been partially fed by Mill Pond. Significant precipitation events do increase the flow of the seep, but to a much smaller extent than was previously observed (Sept. 1997). The configuration of the bedrock surface and/or the size of surface catchment area are such, that part of the precipitation falling on the surface is still directed towards the seep.

The effect of draining Mill Pond on the re-routing of the contaminant loading of Boomerang Lake from the mine site was not addressed, because of lack of the appropriate database. A number of questions are, however, raised. These are:

- If the water balance on the mine site is considered prior and after the draining of Mill Pond is there a noticeable difference? If so why.

- Has the overall contaminant loading of Boomerang Lake changed?

It is known from previous work, that somewhere on the Mine Site, there are buried bedrock low areas and possibly an ancestral drainage system.

- Is there any indication from the analysis of the water balance, that losses occur, which cannot be accounted for if all surface inputs and outputs are considered?

Draining of Mill Pond has also resulted in a significant lowering of the water table in the adjacent sediments. It is known that vast quantities of waste rock make up the adjacent sediment. The lowering of the water table in this type of rock will expose unweathered sulfides, which, undoubtedly, will result in increased acid generation. Has any thought been given to add amendments to these areas of waste rock to limit the acid generation capacity?

FIGURES ARE ON ENCLOSED EXCEL SPREAD SHEET

Figure	Chart
1	1
2	7
3	3
4	9
5	5
6	10
7	11

FIGURE 1. ELEVATION WATER LEVELS IN M13, M14, M15, M18, M38, M57, PRC, SHAFT, MP AND FLOW @ WHS AND WHSS, SINCE START OF DRAINING MILL POND OVER PERIOD JUNE 3 - JULY 4, 1998

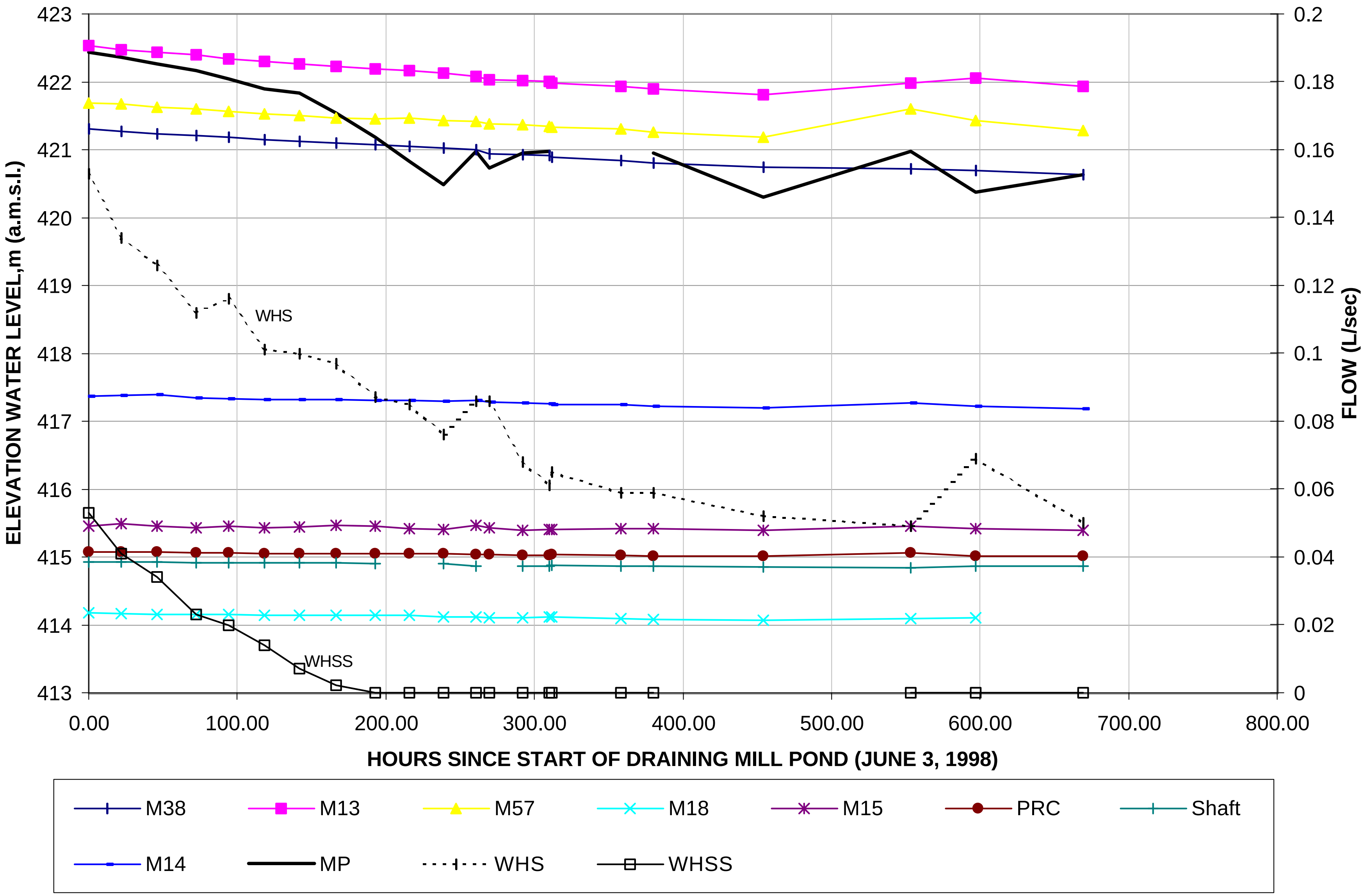

FIGURE 2. CHANGE IN ELEVATION OF WATER LEVEL AT VARIOUS MEASURING POINTS ON THE MINE SITE OVER THE PERIOD: JUNE 3 (start draining mill pond) AND JULY 4, 1998

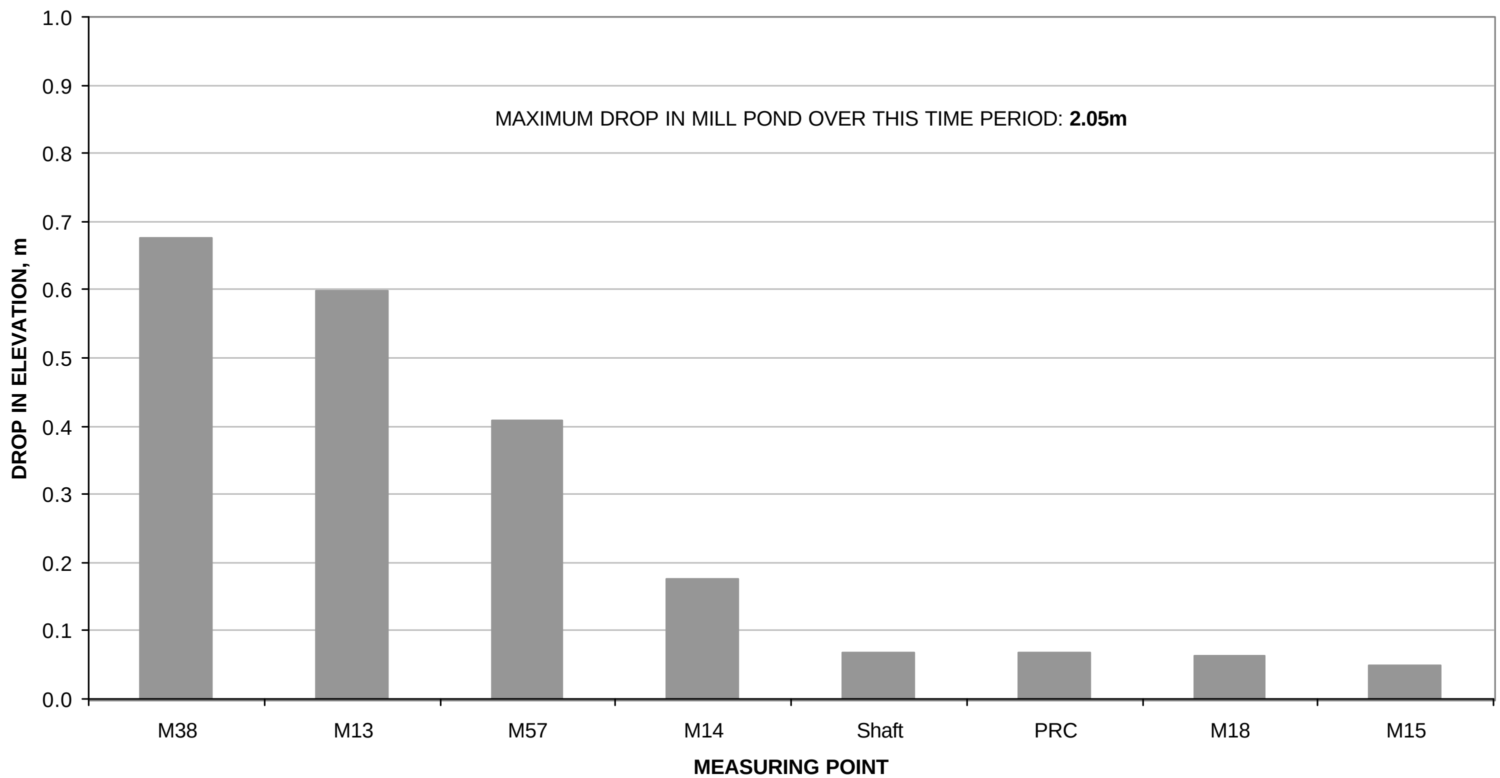

FIGURE 3. CHANGE IN ELEVATION OF WATER LEVEL AT VARIOUS PIEZOMETERS WEST-SOUTHWEST OF TAILINGS BASIN OVER PERIOD: JUNE 4 - JULY 1,1998

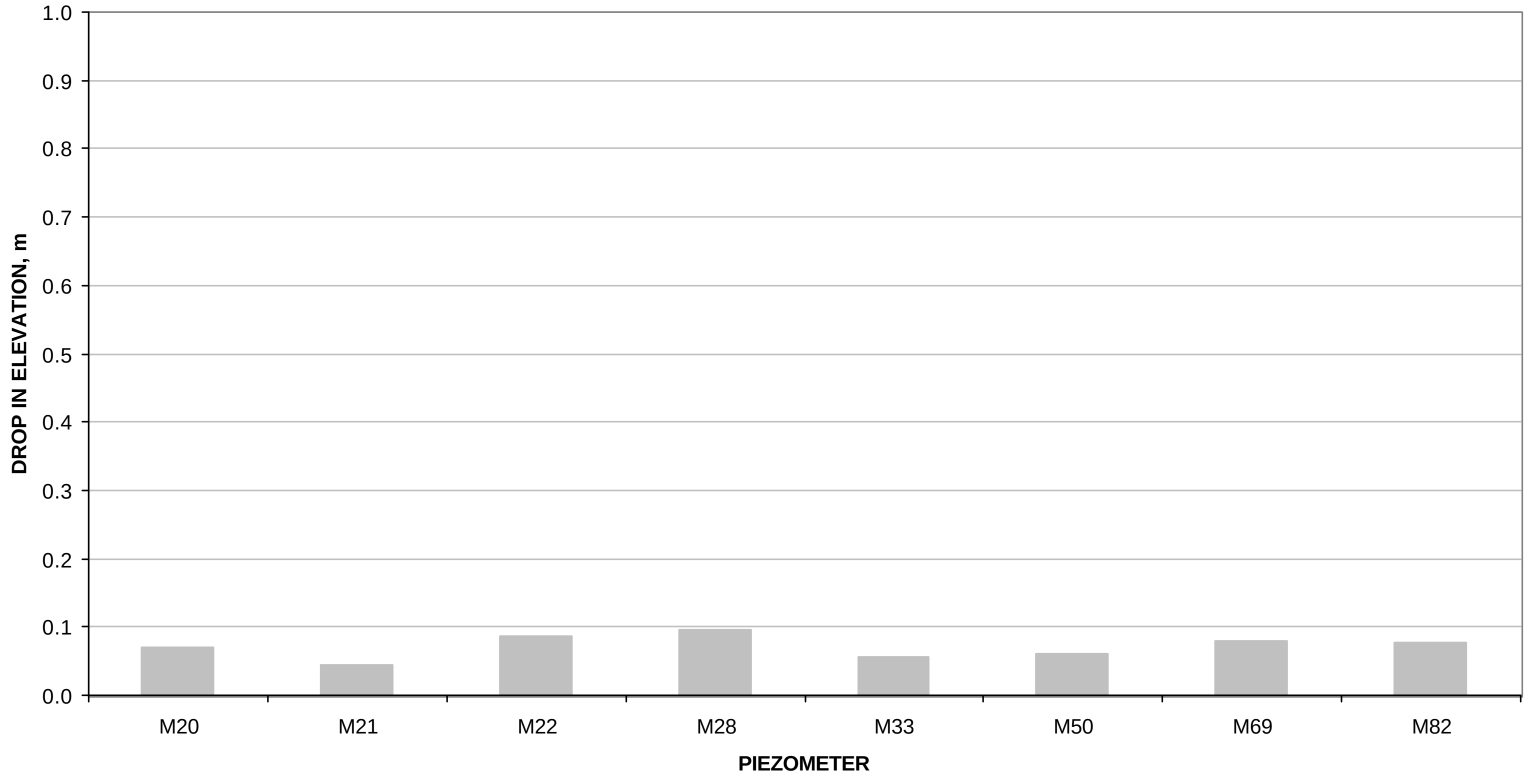

FIGURE 4. ELEVATION WATER LEVEL MILL POND, FLOW @ SIPHON AND PRECIPITATION
OVER PERIOD JUNE 3 - JULY 4, 1998

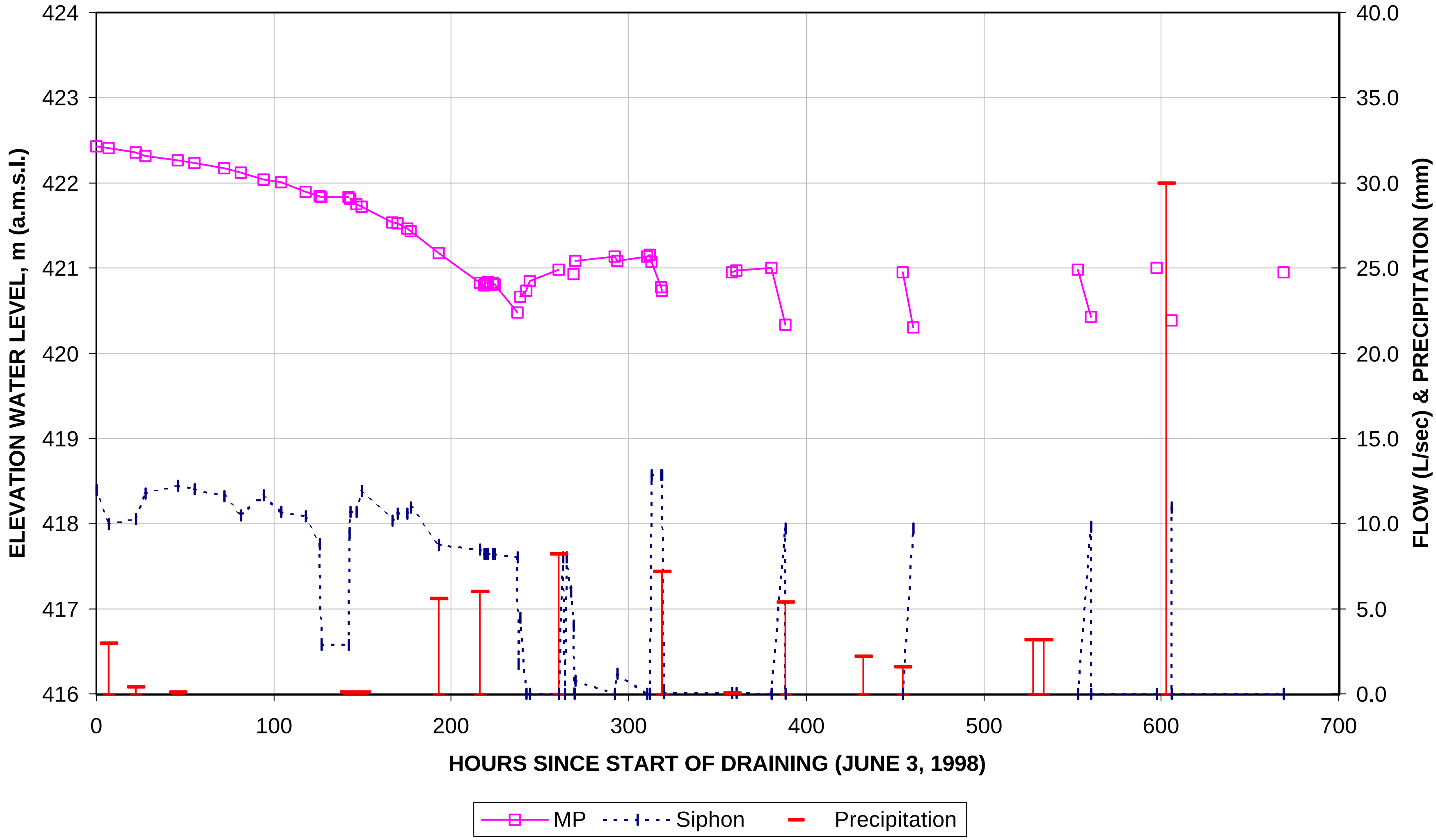

FIGURE 5. ELEVATION OF WATER LEVEL IN M13, M38 & M57AND PRECIPITATION OVER PERIOD JUNE 3 - JULY 4, 1998

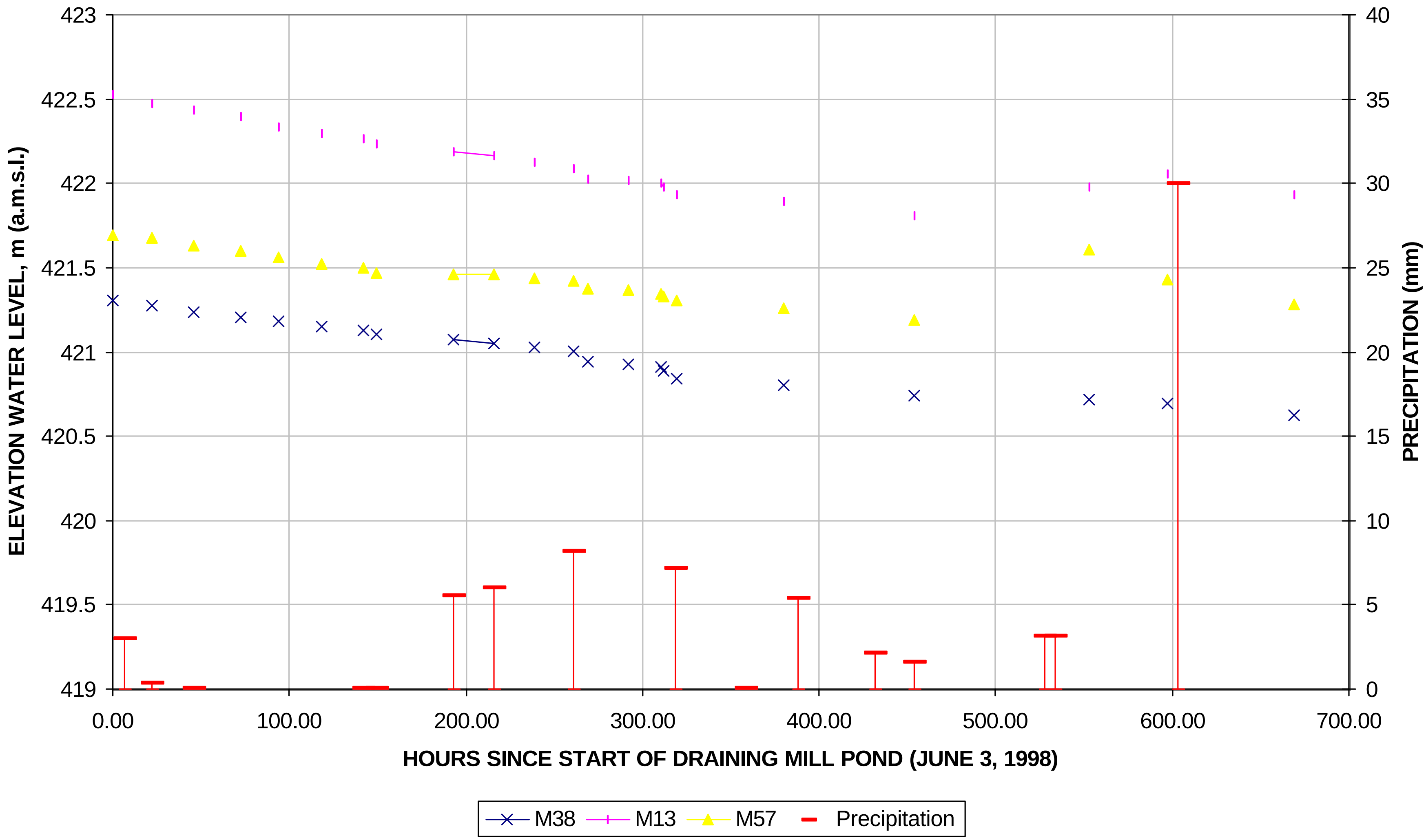

FIGURE 6. CHANGE IN ELEVATION OF WATER LEVEL IN PRC, SHAFT, M15, M18 AND PRECIPITATION SINCE START OF DRAINING MILL POND OVER PERIOD JUNE 3 - JULY 4, 1998

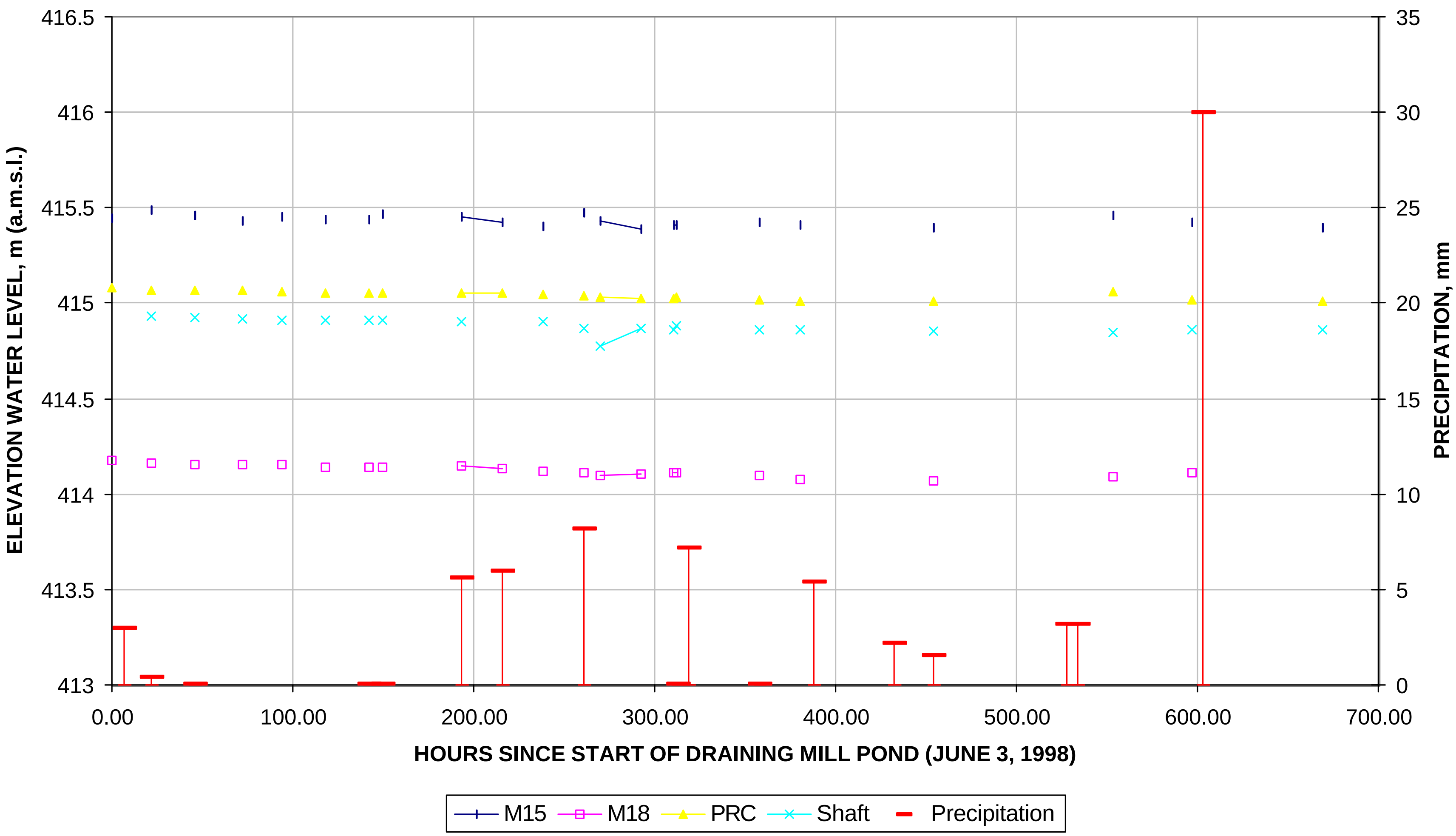

FIGURE 7. FLOW AT WHS, WHSS, BRC @ BR2.5 AND PRECIPITATION SINCE START OF DRAINING MILL POND OVER THE PERIOD JUNE 3 - JULY 4, 1998