Implications of the Draining of Mill Pond: ADDENDUM

January 1999

5

IMPLICATIONS OF THE DRAINING OF MILL POND: ADDENDUM

Review prepared for M. Kalin, Boojum Research Ltd, Toronto

Vonhof Consulting Ltd, Calgary, Alberta.
January 20, 1999

The effect of the draining of Mill Pond was described in detail in a report completed in July 1998. The previous report describes the data collected up to early July 1998. This report summarizes the data collected until December 1998.

Figure 1 shows the trend of the flow at BRC, WHS & WHSS from June 1997 – December 1998. The draining of Mill Pond was started on June 3, 1998. This figure clearly shows that:

1. The flow at WHS and WHSS during 1997 shows a declining trend from summer to late winter, which is occasionally accentuated by major rainfall events (Sept.16, 1997: 28.6mm).
2. The flow at seeps WHS & WHSS is immediately affected by the draining of Mill Pond. The seep WHSS stopped flowing on June 11, 1998. At this time the water level in Mill Pond had been lowered by 1.25m and 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 (Dec. 8, 1998), the flow had decreased by 87% as compared to June 3, 1998.
3. The flow at WHS in December 1998 is only 20% of the flow in December 1997.
4. Major rainfall events during 1998 (June 28: 30mm; July 4-24: 76.6mm [accumulated]; October: 53mm [accumulated]) have comparatively little effect on the flow at WHS.
5. The draining of Mill Pond has drastically reduced the flow at WHS and stopped the flow at WHSS.

6. The flow at BRC shows a gradual increase from June 1997 – October 1998.

The trend of the elevation of the water level in various piezometers, the shaft and PRC is plotted in Figures 2 and 3. Figure 2 shows that:

1. The trend of the elevation of the water level in M13 and M57 is essentially the same. Both piezometers show a rapid decline over the period from June 3 – July 4, 1998. Subsequently, the elevation of the water level in these piezometers appears to be primarily controlled by recharge from significant rainfall.
2. The trend in the elevation of the water level in Mill Pond over the period from July 4 – December 8, 1998 is poorly defined, because only a very few measurements were taken. It appears to remain more or less the same, except for occasional significant rainfall input (July).
3. The trend of the elevation of the water level in M38 shows a continuous decline and is only marginally affected by the rainfall events. The total decline in the elevation of the water level in this piezometer approaches the decline in the elevation of the water level in Mill Pond from June – October 1998.

The change in the elevation of the water level versus time in piezometers M14, M15, M18, PRC and the Shaft (Fig. 3) shows similar trends and appears to be only slightly affected by major precipitation. The "strongest" response to significant rainfall is shown in M18.

The long-term trend of the elevation of the water level in piezometers M13, M38 & M57over the period 1995-1999 is shown in Figure 4. This figure shows that the trend of all piezometers is very similar, except for piezometer M38 in 1998. This latter piezometer shows a definite decline in the elevation of the water level since June 1998 in comparison to piezometers M13 and M57.

The long-term trend of the elevation of the water level in piezometers M14, M15, M18, M20, M28, PRC & Shaft over the period 1995-1999 is shown in Figure 5. M20 & M28 were included to show the trend of the water level in deep piezometers outside the Minesite. This figure shows that:

1. The trend of the elevation of the water levels is very similar for all measuring points, except M14. This latter piezometer shows a definite decline from July 1998 onward, contrary to the trend exhibited by all other measuring points. This implies, in all likelihood, that the draining of Mill Pond also affected the elevation of the water level in M14, albeit to a much smaller extent than in M38.
2. The trend of the elevation of the water level in PRC and the Shaft is a subdued replica of most of the other piezometers. This is not too surprising, if it is considered that the Shaft and the PRC are connected to the mine workings. The water level at these measuring points reflect, therefore, the very deep regional groundwater flow system in the area.
3. If the trend of the elevation of the water levels over the period June-December in 1997 is compared with the same period in 1998, it is obvious that the elevation is slightly higher in 1998. The outflow from the BRC is derived from the mine workings, i.e. the deep regional groundwater flow system. If the contention were true that, in a regional sense, the elevation of the water level is higher in 1998, it would explain the observed increase in the flow from BRC during 1998 (Fig. 1).
4. The elevation of the water level in PRC is consistently higher than in the Shaft and both are higher than the elevation of the constant hydraulic head water level in BRC. Fluctuation in the elevation of the water level in PRC and the Shaft are expressed by

an increase or decrease in the outflow of BRC. The Backfill Raise has been flowing for several years. The Shaft is located farther away from the BRC than the PRC. The BRC acts as a constant hydraulic head outflow from the deep groundwater flow system. If the Shaft, BRC and PRC were connected by an open unrestricted network of mine workings, the water level in the PRC should have been lower than the Shaft because of distant-drawdown relationships. However, the elevation of the water level in the Shaft is consistently lower than in the PRC. This strongly suggests that a significant permeability reduction is present in the pathway between the PRC and the BRC.

EM SURVEYS.

EM surveys were conducted on the Minesite during September 1998. Of particular interest are the two maps with a coil separation of 10 and 20m respectively. Both maps show that contaminated water is flowing from the PRC towards Confederation Lake.

With respect to the Mill Site the 20m spacing map shows a strong anomaly north-northeast of Mill Pond. The area of the anomaly was a pre-existing topographic low. The shape of the anomaly is a rectangle. This strongly suggests that the highly conductive waste was placed in a confined area, in other words, in a diked area. A contaminant tail appears to be present from this rectangle in a southwesterly direction towards Mill Pond. The 10m coil spacing shows that the north boundary is still linear and in the same place, but the other boundaries are much more diffuse and the anomaly covers a considerably larger area towards the south and southwest, i.e. the direction of Mill Pond.

The EM survey also shows that very low conductive areas bound the highly conductive anomaly to the north, east and southeast. These low conductive areas are in all likelihood bedrock high's.

Based on the surface topography there appears to be a groundwater divide north-northeast of Mill Pond and relatively close to Mill Pond. The draining of Mill Pond has undoubtedly lowered the watertable in this area and thus modified the configuration of the watertable. It is not known if the groundwater divide is still present after the draining of Mill Pond. Depending on the bedrock topography and the stratigraphy of the sediments overlying the bedrock surface, the existence of a groundwater divide may have contained contaminant migration from the EM anomaly in a southerly direction. If this contention were true, than the removal or drastically changed groundwater divide would promote a greater southward spread of contaminants from the EM anomaly towards Mill Pond. This can only be determined from test drilling and piezometers.

The spatial position of the contaminated waste in the subsurface is not known. How thick is the waste? Is the waste confined by dikes as suggested by the shape of the EM anomaly? What underlies the waste? Did the contaminant plume emanating from the anomaly in a south-southwesterly direction result from overflowing over the dikes or is it located in unconsolidated sediment below the pre-existing surface upon which the waste was placed. Where is the position of the watertable with respect to the top of the waste and the top of the dikes? Testdrilling and piezometers can only provide the answers to these questions.

RECOMMENDATIONS.

A bedrock outcrop map should be constructed on the same scale as the EM plots to correlate the EM survey to the bedrock.

It is strongly recommended, that a number of testholes are drilled in the EM anomaly and surrounding area and that piezometers are installed in the boreholes to obtain at least partial answers to the above questions. The piezometers are also necessary to monitor the progress and effectiveness of amendment applications in this area.

The existing piezometers were sampled at the start of the draining of Mill Pond. All piezometers should be sampled again prior to and after spring runoff to determine if the draining of Mill Pond changed the groundwater chemistry in the area. An effort should be made to revive and sample piezometer M12, because this piezometer showed a considerable contaminant load in the past.

The draining of Mill Pond has had a significant effect on the flow of WHS and WHSS, two major sources of dissolved metal ions for the Backfill Raise Diversion Ditch. The water level in Mill Pond should, therefore, be maintained at an elevation, which ensures low flow (WHS) and no flow (WHSS) conditions at the seeps. Based on a review of the data, the elevation of the to be constructed outflow of Mill Pond should be between 420.50 – 420.75m.

COST ESTIMATE DRILLING & PIEZOMETER INSTALLATION

Mine Site

Mobilization/Demobilization	$ 2990.00	
Sustenance 3 days @ $225/day	$ 675.00	
Travel to & from site 3 days, 3 hrs/day @ $90/hr	$ 810.00	
Rig time 10 hrs/day, 3 days @ $100.00/hr	$ 3000.00	
Air compressor 3 days @ $250.00/day	$ 750.00	
Water truck 3 days @ $500.00/day	$ 1500.00	
Drilling 250ft @ $18.00/ft	$ 4500.00	
Submursible pump + power plant 3 days @ $170.00/day	$ 510.00	

SUBTOTAL	$14735.00	
Materials		
250 ft PVC @ $2.50/ft	$ 625.00	
25 ft screen @ $5.10/ft	$ 125.00	
10 slip caps @ $1.50/cap	$ 15.00	
15 couplers @ $2.50/coupler	$ 37.50	
10 TDH caps @ $8.75/cap	$ 87.50	
Frac sand	$ 90.00	
Grout, bentonite & polymer	$ 500.00	

SUBTOTAL	$ 1480.00	
TOTAL		$16215.00
15% Contingency		$ 2430.00
GRAND TOTAL DRILLING MINE SITE		**$18645.00**

Kalin Canyon

Sustenance 4 days @ $225/day	$ 900.00	
Travel to & from site 4 days, 3 hrs/day @ $90/hr	$ 1080.00	
Rig time 10 hrs/day, 4 days @ $100.00/hr	$ 4000.00	
Air compressor 4 days @ $250.00/day	$ 1000.00	
Water truck 4 days @ $500.00/day	$ 2000.00	
Drilling 500ft @ $18.00/ft	$ 9000.00	
Submursible pump + power plant 4 days @ $170.00/day	$ 680.00	

SUBTOTAL	$18660.00	
Materials		
500 ft PVC @ $2.50/ft	$ 1250.00	
120ft screen @ $5.10/ft	$ 615.00	
12 slip caps @ $1.50/cap	$ 18.00	
16 couplers @ $2.50/coupler	$ 40.00	
12 TDH caps @ $8.75/cap	$ 105.00	
Frac sand	$ 120.00	
Grout, bentonite & polymer	$ 750.00	

SUBTOTAL	$ 2898.00	
TOTAL		$21558.00
15% Contingency		$ 3230.00
GRAND TOTAL DRILLING KALIN CANYON		**$24788.00**

Supervision and Fieldwork both projects

J.A. Vonhof 11days (including travel, water sampling,	
slug testing, surveying) @ $800.00/day	$ 8800.00
Sustenance 10 days @ $75/day (based on shared room)	$ 750.00
Travel Calgary to site and back	$ 1000.00
Rental slug test equipment & shipping charges	$ 250.00
Report preparation 10 days @ $800.00/day	$ 8000.00

TOTAL **$18800.00**

GRAND TOTAL BOTH PROJECTS **$62233.00**

NOT INCLUDED IS THE GST, COST OF FIELD VEHICLE & COST OF BOOJUM PERSONNEL. (ONE EXTRA PERSON WILL BE REQUIRED DURING FIELD OPERATIONS)

RE: Program Kalin Canyon.

A minimum of 4 piezometers will be required at each location: M79, M80 & M81 to cover the thickness of the contaminated water, the transition zone and the fresh water zone, without creating significant problems of cross formational flow. One deep piezometer, immediately above the bedrock surface, is already present at these locations and one fresh water piezometer (M73) near M81 is also present. It is suspected that the most economical way to apply the amendment to the Kalin Canyon would be by means of a trench constructed to the depth of the watertable upstream of M79, M80 & M81. In order to monitor the migration of the amendment another single set of 4 piezometers would be required between the trench and the location of M79, M80 & M81.

FIGURE 1. TREND IN FLOW @ BRC, WHS & WHSS OVER PERIOD JUNE 1997 - DEC. 1998

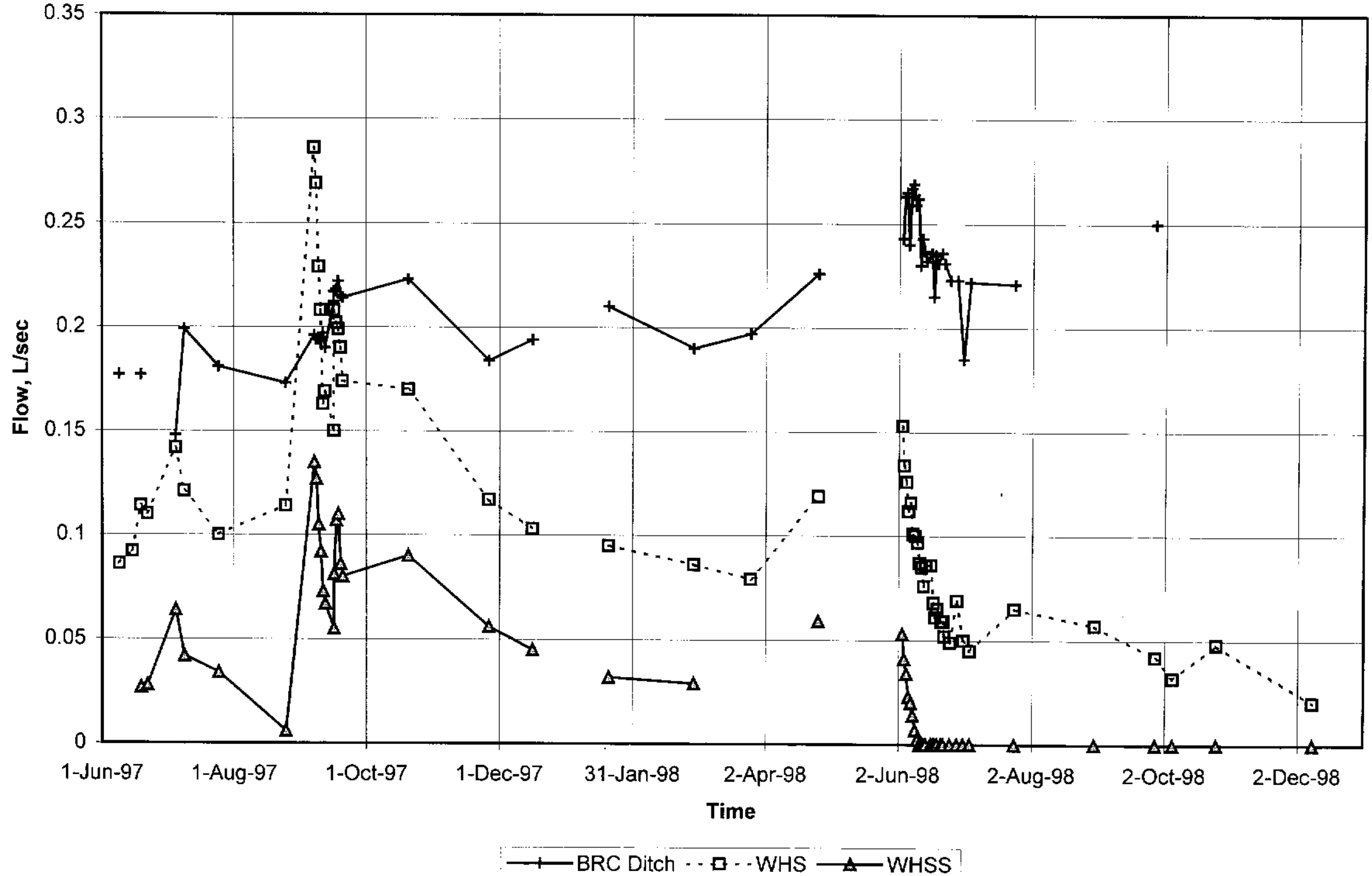


FIGURE 2. TREND OF ELEVATION OF WATER LEVELS IN M13, M38, M57 & MP AND PRECIPITATION OVER PERIOD MAY-DEC. 1998

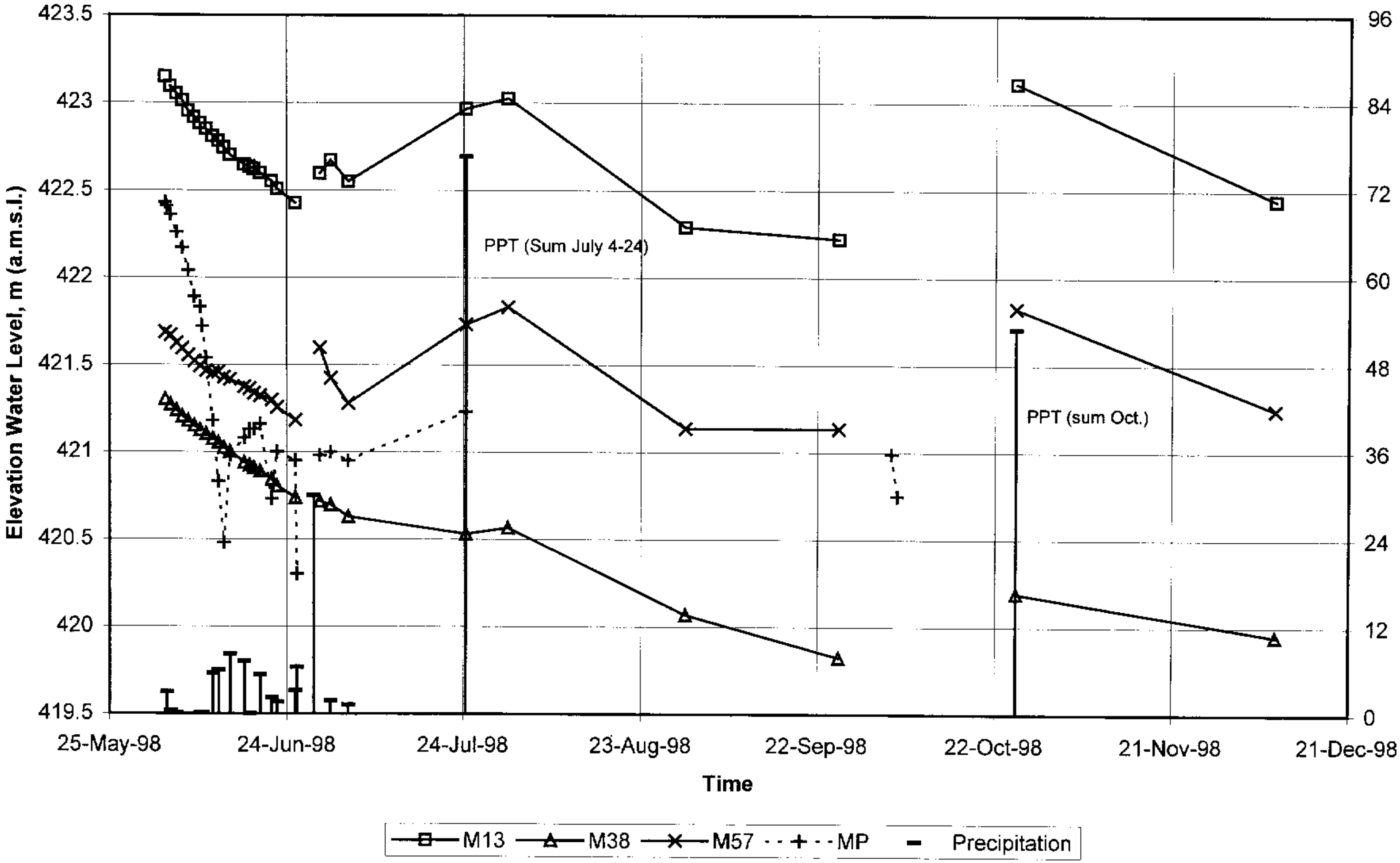


FIGURE 3. TREND OF ELEVATION OF WATER LEVEL IN PIEZOMETERS: M15, M18, SHAFT & PRC AND PRECIPITATION OVER PERIOD MAY-DEC. 1998

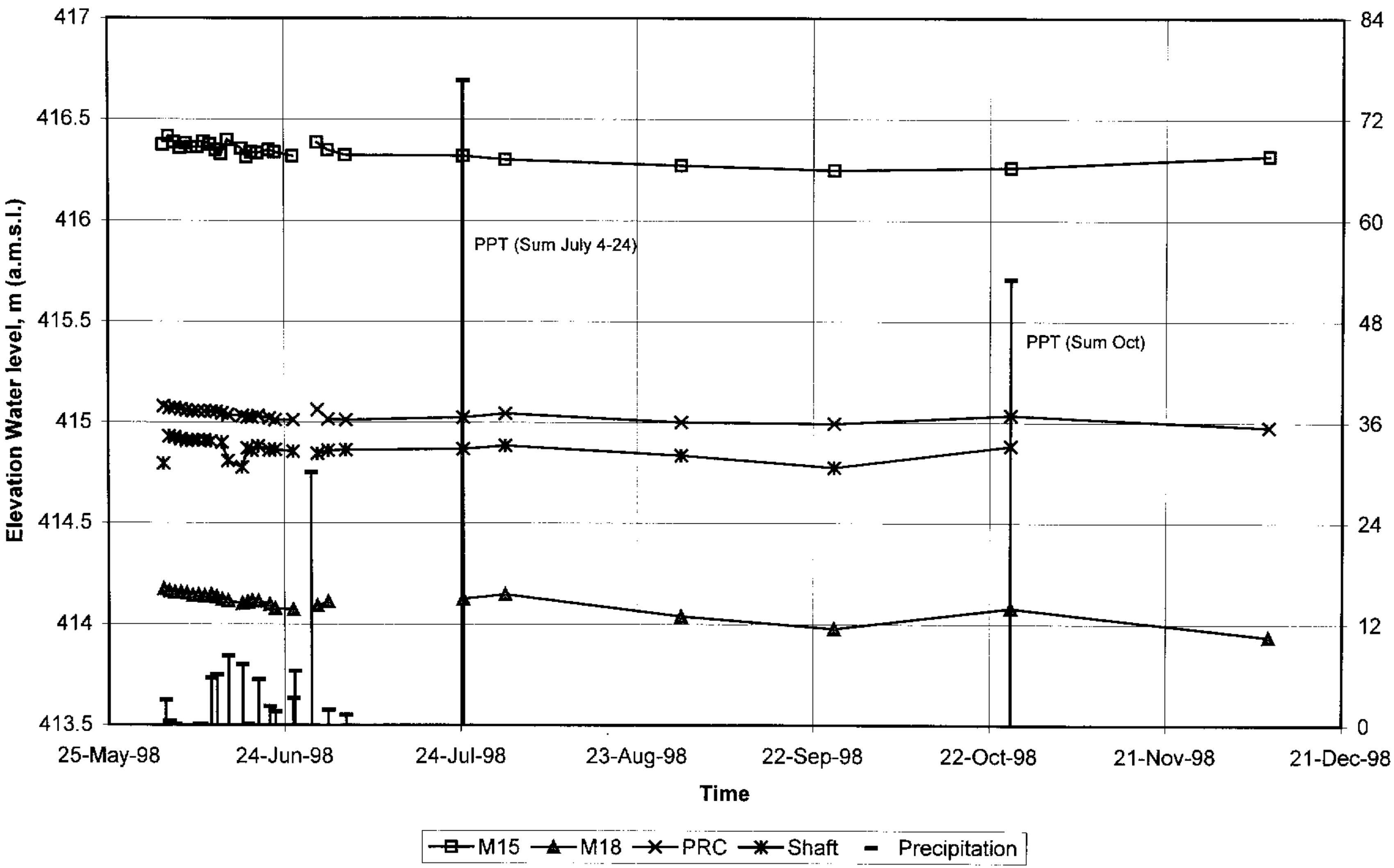


FIGURE 4. LONGTERM TREND OF ELEVATION OF WATER LEVEL IN PIEZOMETERS: M13, M38 & M57 OVER PERIOD 1995-1999

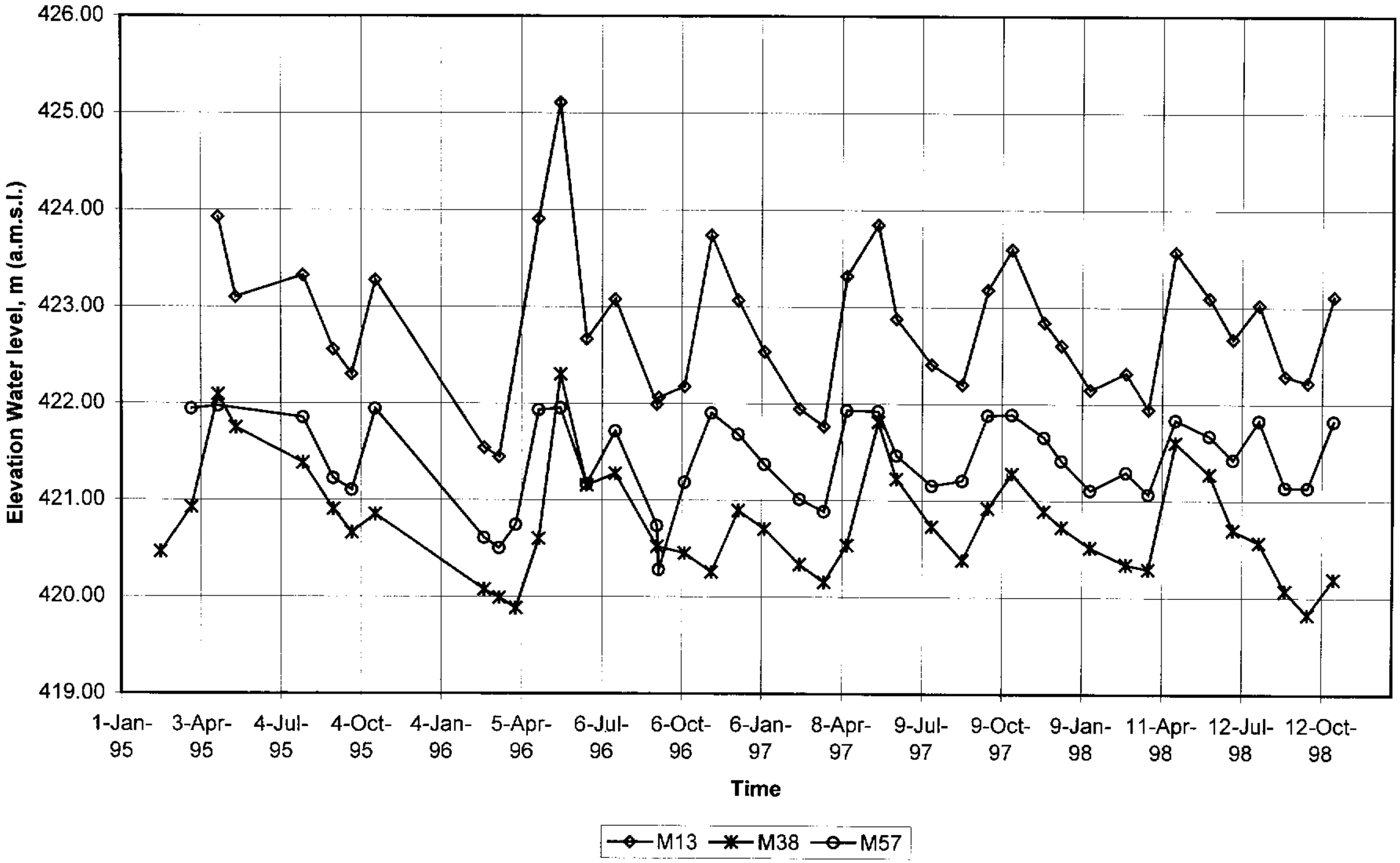
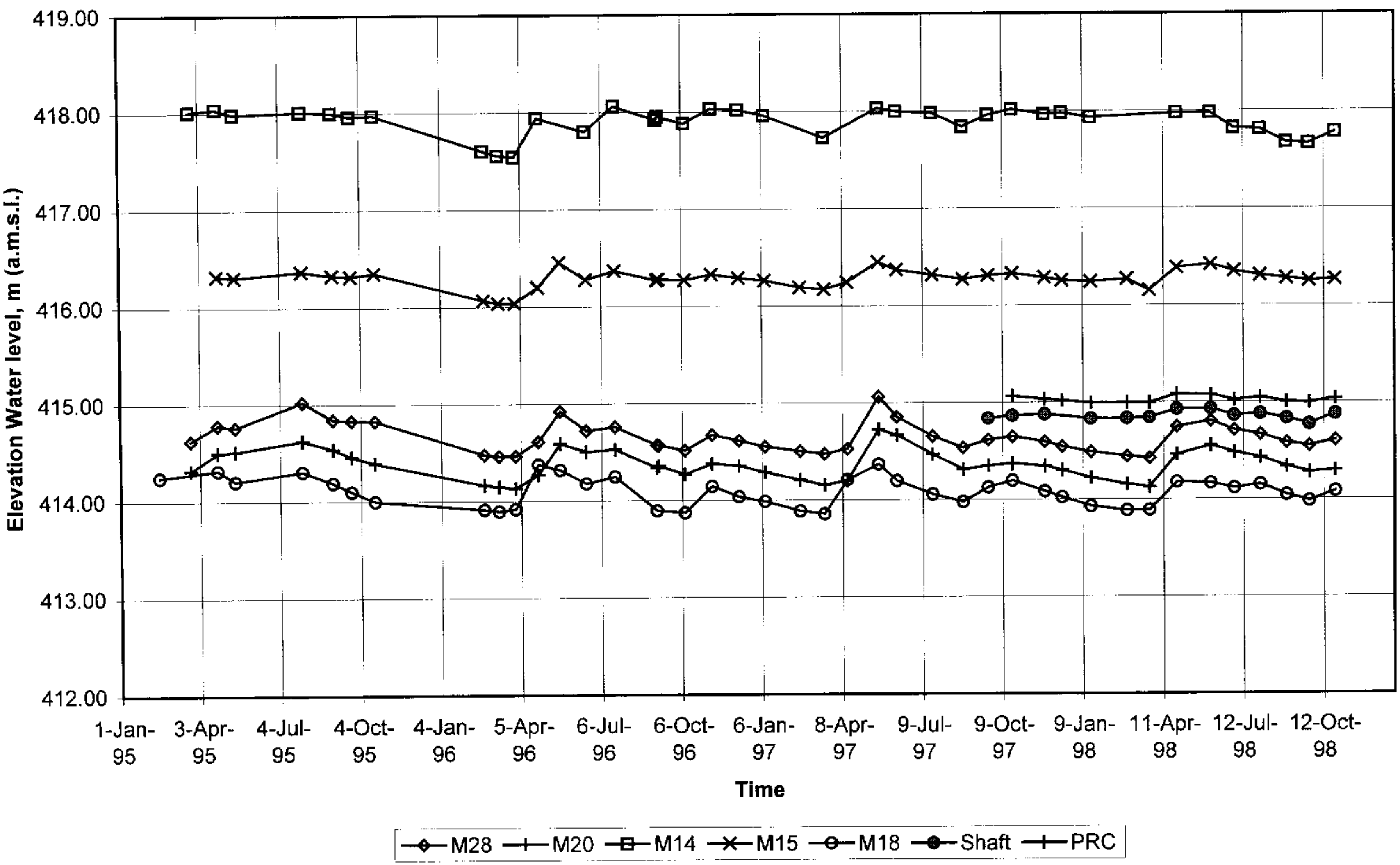


FIGURE 5. LONGTERM TREND OF ELEVATION OF WATER LEVEL IN PIEZOMETERS: M14, M15, M18, M20, M28, SHAFT & PRC OVER PERIOD 1995-1999



VONHOF CONSULTING LTD
1610 2A STREET N.W.
Calgary, Alberta
T2M 2X4
(403) 277-7827

DATE: January 21, 1999

Invoice # :VON 99-001

IN ACCOUNT WITH: BOOJUM RESESARCH LIMITED
LL2,468 Queen Str. E.,
Toronto, Ontario
M5A 1T7

RE: Review of draining of Mill Pond, South Bay, Ontario and cost estimates

PROFESSIONAL SERVICES:

PERIOD : January,1998

3.0 days @ $800.00/day......................$ 2,400.00

GST @ 7% (**Account # R 105558217**).............$ 168.00

TOTAL BILLING: $ 2,568.00

Certified Correct: ______________________
J.A.Vonhof