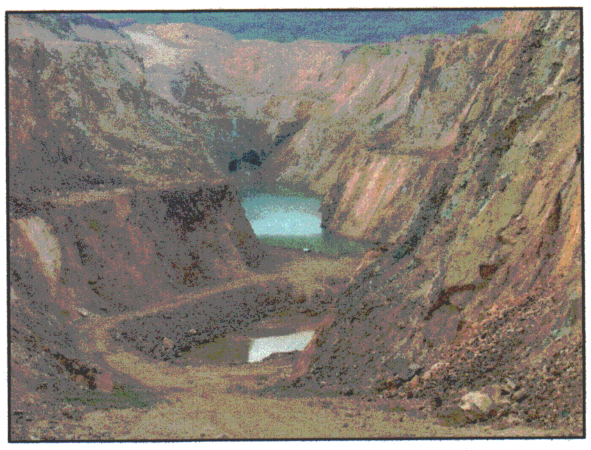
Phase I – Mt. Nansen Mine Site, Brown-McDade Pit Summer Monitoring, 2004 – Data Summary Report



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March 3, 2005

Hugh Copland, Project Manager
Energy, Mines and Resources
Abandoned Mines Project Office
Box 2703
Whitehorse, Yukon Y1A 2C6

Dear Mr. Copland:

Re: 40-568 – Phase I - Mt. Nansen Mine Site, Brown McDade Pit Summer Monitoring 2004 –Data Summary Report

We are pleased to present you with two copies of our report entitled "Mt. Nansen Mine Site, Brown McDade Pit Summer Monitoring 2004 –Data Summary Report". Please review at your earliest convenience and contact me to discuss your comments.

Please do not hesitate to contact me at ext. 24 should you have any questions. We thank you for the opportunity to complete this phase of the project and look forward to assisting you with future work at the site.

Yours very truly,
GARTNER LEE LIMITED

Martin Guilbeault, M.Sc., P.Eng.
Hydrogeologist
MG:mg

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1. Background

Site monitoring of the Mt Nansen mine Brown-McDade open pit and adjacent Pony Creek was undertaken in 2004 as a result of recommendations outlined by Gartner Lee (2004). The focus of the study was to develop an understanding of the pit water elevation behavior and the associated water quality. A more detailed description of site history and related care and maintenance issues is provided by Gartner Lee (2004). This work is outlined in phase I of the June 15 memo entitled "23669 – Mt Nansen, Brown McDade Pit Summer / Fall 2004 Revised Monitoring Plan". As outlined in the memo, phase I of the workplan consisted mainly of data acquisition over the summer of 2004. Consequently, the following consists mainly of a data presentation report with minimal interpretation. A more detailed review of the data should be conducted in order to determine and assess final closure options specifically as they relate to the Brown McDade open pit. This is outlined in phases II and III of the above mentioned memo.

2. Introduction

The main components of the 2004 pit water balance are shown in Figure 1. GLL (2004) noted that frozen seepage faces were observed in the northern end of the pit during field work in February. This was consistent with the overall water balance model that predicted significant seepage into the pit during the summer season. This is shown schematically in Figure 1. It was also anticipated that the rate of this seepage would be variable throughout all non-frozen conditions and seepage rates would likely depend on input source variability (i.e. Pony Creek drainage flow) and ground conditions (frozen ground or not and/or the nature of fractured rock).

The main relevant recommendations from the GLL (2004) report are:

Water Balance

- Continuous monitoring of pit lake water levels
- Continuous acquisition of site specific meteorological data
- Qualitative observations (photos, notes, videos) of site conditions:
    - Snowmelt
    - Runoff
    - Drainage patters
    - Pit seepage patterns
    - Streamflow
- Quantitative measurement of water balance components
    - streamgauging

- Seasonal monitoring of seasonal changes in water balance components
- Determine water table using boreholes and observation wells
- Determine elevation of Pony Creek adit
- Examine condition of Pony Creek adit
- Determine source of seepage to pit
- Examine pit walls during non-frozen conditions
- On-going calibration and refinement of model with new data

Water Quality

- Collect and monitor seasonally water quality of all water balance components
- Conduct seasonal profiles of pit lake quality
- Collect depth-discrete samples at several locations in pit
- Use a mass balance approach to model pit chemistry

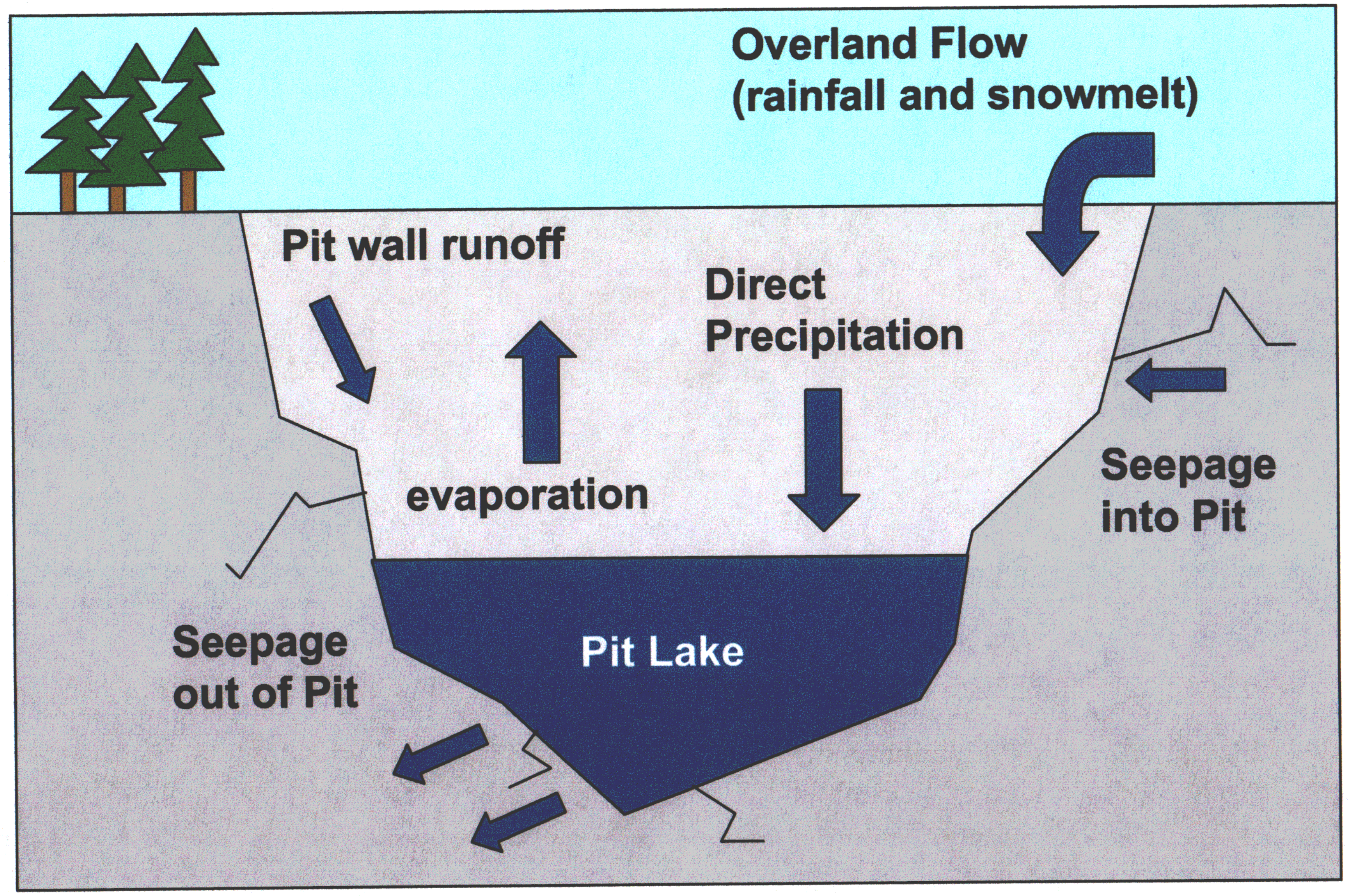


Figure 1. Conceptual Model of Pit Water Balance (GLL, 2004)

2.1 Study Goals and Approach

The main goals of the summer 2004 study were the following:

- make key observations (using digital photography and video) about the nature of surface water runoff to the pit, possible groundwater discharge points downgradient of pit, drainage patterns, runoff from pit wall benches and pit walls and seepage into the pit and establish possible monitoring locations and methods for water quality and flow.
- develop a sampling, monitoring and site instrumentation plan
- instrument the site in a manner that would facilitate temporal monitoring during summer/fall
- collect flow measurements and water quality for different water balance components such as seepage into the pit (from North end) and pit walls and observe temporal variations in site hydrology and hydrogeology.
- determine the evolution of chemical and thermal stratification in the pit during non-frozen periods

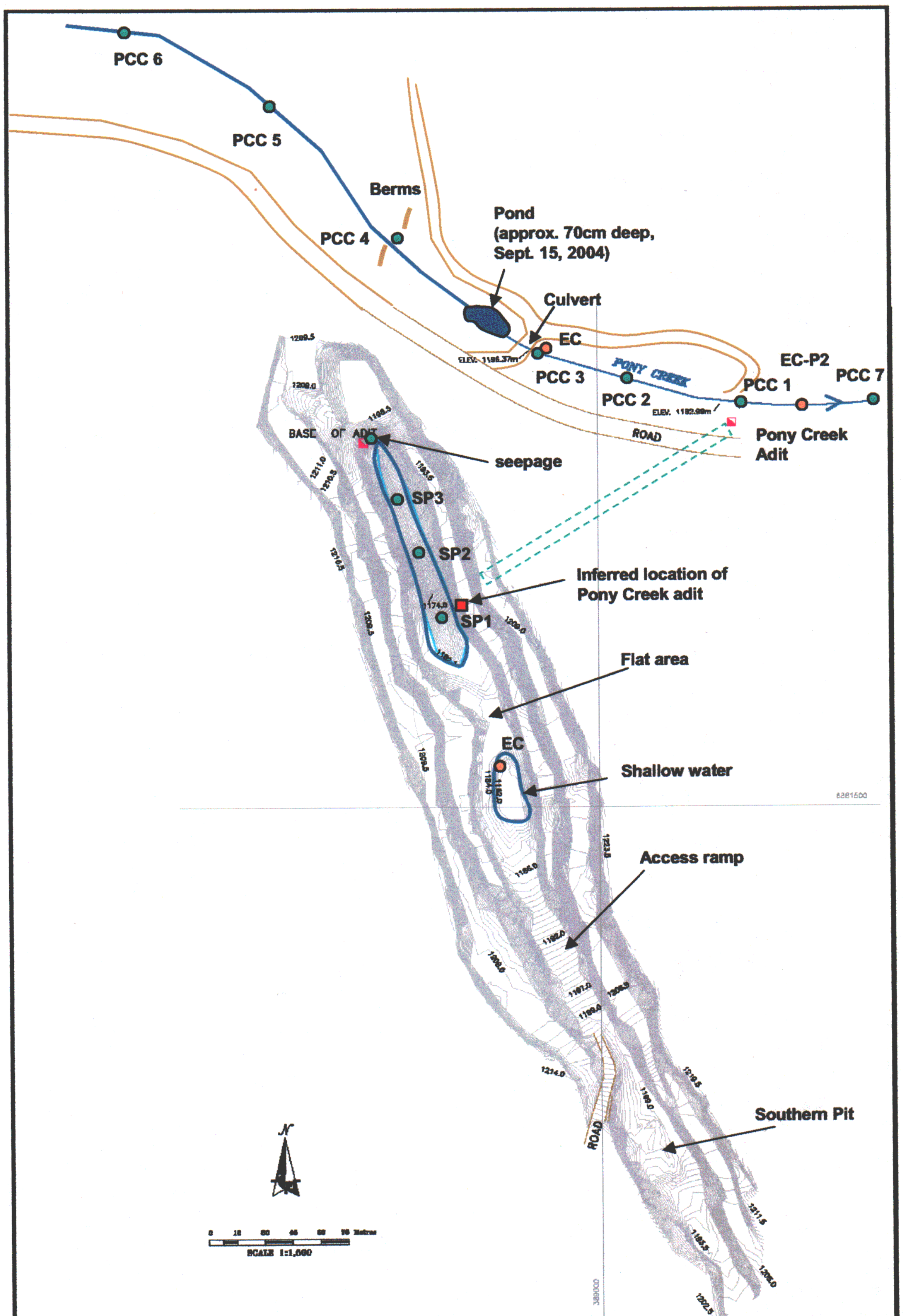
Field work was performed during 3 monitoring periods (July, August and September). During this time, the hydrological and hydrogeological conditions at the site were monitored by:

- surveying relevant locations of monitors and Pony Creek adit (not identified during frozen periods) using hand-held GPS and level
- establishing depth profiles of water quality parameters (dissolved oxygen, ORP, pH, Temp., Conductivity) at three or more locations
- collecting water quality samples for chemical analyses (both dissolved and total metals and other relevant parameters) at several locations within the pit
- collecting samples of seepage into the pit to determine water quality
- collecting samples of surface water in Pony Creek to establish background water quality upstream and downstream of the pit and Pony Creek adit
- collecting flow measurements to estimate water balance components

3. 2004 Summer Monitoring Work

3.1 Introduction

Gartner Lee personnel were present at the site on July 13th and 14th, August 18th and September 15th. Personnel from Environment Canada (EC) (Whitehorse) also accompanied GLL to the site on September 15th to perform flow and water quality measurements at the site. Analytical results collected by EC and relevant to this study are presented in this report. The July field episode consisted of establishing stream flow measurement and water quality monitoring sites along Pony Creek. These were installed at seven locations (PCC1 to PCC7) starting downstream of the Pony Creek adit and extending upstream of the pit (Figure 2). Locations SP1, SP2 and SP3 are monitoring locations within the pit lake. A permanent mark was painted along the pit wall a few meters above the surface of the water to allow sampling to occur at approximately the same locations throughout the monitoring period. Several samples were also collected from the north end of the pit near the adits.



LEGEND:

- CREEK
- GROUND SURFACE CONTOUR (mASL)
- LEVEL OF ICE (MARCH, 2004)
- ADIT
- 2004 Sampling Points (GLL)
- 2004 Sampling Points (EC)

Note: Road, Creek and Sampling Locations are approximate

SOURCE OF DRAWING: SURVEY BY UNDERHILL SURVEYORS CONDUCTED IN MARCH, 2004

CONTOURS IN mASL

NAD 83 ZONE 8

DATE ISSUED: JUNE, 2004

Figure 2.
2004 Monitoring Sites

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3.2 Field Methodology and Data

A summary of field activities and samples collected is presented in Table 2.

3.2.1 Flow Measurements in Pony Creek and Seepage Rate Estimates

Photographs of Pony Creek flow and measurements are included in Appendix A. Pony Creek has one main small channel of approximately a few feet in width as it flows past the pit. The streambed consists mostly of sand and gravel and in some cases organic material. The stream channel meanders throughout the drainage area flows through a culvert beneath an access road as it passes the pit (PCC3). There is a small pond of approximately 70cm in depth (July 2004) upstream of the roadway. A few other areas of ponded water were observed further upstream of the roadway and upstream of large earth berms that cross perpendicular to the floodplain where frozen surface water was observed in February 2004. Due to the nature of the stream (narrow, shallow, small waterfalls), flow in Pony Creek was measured by using a stopwatch and graduated container (Table 1). During all three monitoring days (July, Aug., Sept.), surface water flowed past PCC1 and quickly disappeared to groundwater as the Creek flows over sand and gravel fill that was emplaced near the Pony Creek adit during operational times. Flow reappears a few hundred meters downstream before PCC7. Results in Table 1 show that flow is variable between locations likely due to the heterogeneous nature of the drainage areas (i.e. stream inflows from the side-valleys, flow through the hyporheic zone into pools and riffles). Also, the lowest flows were observed in July and the highest in September. This could be due to a combination of factors such as July being an extremely dry month and more rainfall and snowmelt occurring in September.

Table 1. Summary of 2004 Flow measurements in Pony Creek (L/s)

Location	July	August	September
PCC6	0.47	0.9	1.9
PCC5	0.81		
PCC4	0.76		
PCC3	0.64	1.0	2.6
PCC2	0.30		
PCC1	0.03	0.3	1.1
EC-P2			0.7
PCC7	0.70	1.0	2.6

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Table 2. Summary of 2004 Field Activities

Date	Description of Activities	Details	Samples Collected
4-Feb-04	photo documentation of Pony Creek and pit conditions		
	sampling of Pit water quality through the ice	3 locations (SP1, SP2, SP3)	SP1-1m
		duplicate of SP1-1m	SP1-1m-D
			SP1-4m
			SP1-8m
			SP2-1m
			SP2-3.5m
			SP3-1m
			SP3-3m
16-Jun-04	grab sample (from surface) of Pit water	YG Water Resources	
29-Jun-04	grab sample (from surface) of Pit water	YG Water Resources	
July 13-14, 2004	Set-up of monitoring locations		
	Stream flow measurements of Pony Creek	7 locations	
	Inspection of Pony Creek Adit		
	Sampling of Pony Creek Water Quality	2 locations	PCC6
			PCC7
	photo and video documentation of Pony creek and pit conditions		
	Qualitative pit water quality profiling (DO, Temp, ORP, pH, sp. Cond.)	3 locations (SP1, SP2, SP3) (>35 depth discrete measurements)	
	sampling of Pit water quality	3 locations (SP1, SP2, SP3) (7 samples)	SP1-0m
			SP1-3m
			SP1-5.5m
			SP2-0m
			SP2-5.5m
			SP3-0m
			SP13-3.5m
	sampling of seepage water quality	from eastern adit in north end	SEE1
		duplicate of SEE1	SEE1-D
		from ponded water	SEE-PO
	flow estimates of seepage rates		
14-Jul-04	grab sample (from surface) of Pit water	YG Water Resources	
28-Jul-04	grab sample (from surface) of Pit water	YG Water Resources	
11-Aug-04	grab sample (from surface) of Pit water	YG Water Resources	
19-Aug-04	Stream flow measurements of Pony Creek	4 locations	
	Sampling of Pony Creek Water Quality	1 location	PCC7
	photo and video documentation of Pony Creek and pit conditions		
	Qualitative pit water quality profiling (DO, Temp, ORP, pH, sp. Cond.)	3 locations (SP1, SP2, SP3) (>35 depth discrete measurements)	
	sampling of Pit water quality	1 locations	SP3-0m
	sampling of seepage water quality	ponded water at bottom of adit	SEE-PO
	flow estimates of seepage rates		
26-Aug-04	grab sample (from surface) of Pit water	YG Water Resources	
8-Sep-04	grab sample (from surface) of Pit water	YG Water Resources	
Sept 10 - 15, 2004	Pit Dewatering by YTG personnel	3249 m^3 removed within 120 hours using continuous pumping	
16-Sep-04	Stream flow measurements of Pony Creek	5 locations (PCC7, PCC1, EC-P2, PCC6 and PCC3)	
	Sampling of Pony Creek Water Quality	3 locations	PCC6
			PCC7
			PCC1
	Sampling of Pony Creek Water Quality (Env. Canada)	2 locations	PCC3
			EC-P2
	photo and video documentation of Pony creek and pit conditions		
	Qualitative pit water quality profiling (DO, Temp, ORP, pH, sp. Cond.)	3 locations (SP1, SP2, SP3) (>35 depth discrete measurements)	
	sampling of Pit water quality	3 locations (SP1, SP2, SP3) (7 samples)	SP1-0m
			SP1-2m
			SP1-4.5
			SP2-0m
			SP2-3.5m
			SP3-0m
			SP3-4m
		Env. Canada. from pond near parking area	EC-SPIT
	sampling of seepage water quality	ponded water at bottom of adit	SEE-PO
		duplicate of SEE-PO	SEE-PO-D
	flow estimates of seepage rates		
	inspection of lower Dome Creek valley		
5-Oct-04	Data Downloading by YTG personnel	pit observed to be frozen	

The only evident source of seepage into the pit was noted in the north end where icicles had been observed in February. Two adit ends (east and west adits) penetrate the pit wall at this location. Flow through the fractured rock into the east adit was evident from significant amounts of water dripping from the ceiling of the east adit and from the rock matrix surrounding the adit. In July, flow was estimated at between 10 and 20 L/s. Field personnel made the flow estimates by measuring the flow rates of the largest and most accessible drips by applying the volume-time method. A large container with a known volume was placed to collect the water from an area of flowing water and the time required to fill the container was noted. The rock walls of the adit were also completely wet and staining from precipitation was observed along fracture planes. This flow contributes a significant input to the overall pit water balance. Seepage from this adit location does not flow directly into the pit but accumulates in a shallow pond in the bottom of the adit. The water level in this pond is a few meters above the pit lake surface. Ice was also observed in this adit in July. This ice had melted by August but the ponded water was still present. Seepage rates into the north-end adit were significantly lower in August and again in September. A soil and rock dam formed by the accumulation of collapsing material at the base of the adit entrance blocks water from running directly into the pit lake. Water from the ponded area likely flows toward the pit through groundwater. This is shown in Figure 3.

There was clear evidence that flow in the east adit resulted from flow through a fracture network not connected to the west adit, located within a few meters. The latter was almost completely dry with only a few drops of water coming from the ceiling of the adit. No ice was present at the bottom of the adit and no significant flow occurred during the three monitoring periods. See Appendix A for a photograph of the adits.

3.2.2 Profiling of Pit Lake

Profiles of Electrical Conductivity (EC), Temperature (T), Dissolved Oxygen (DO), pH and Oxidation Reduction Potential (ORP) were obtained from the pit at three locations (SP1, SP2 and SP3). Measurements were made every 50cm from the water surface to the pit bottom using a YSI 560 MDS datalogger and multiprobe. The instrument was calibrated prior to each field episode. Results are shown in Figure 4, Figure 5, Figure 6, and Figure 7. The data are included in Table 3, Table 4, and Table 5 There is clear evidence of stratification in the pit as suggested by the EC and specific conductance results with higher readings near the bottom of the pit lake. These results are consistent with results from discrete depth sampling in February, which also showed stratification in the pit.

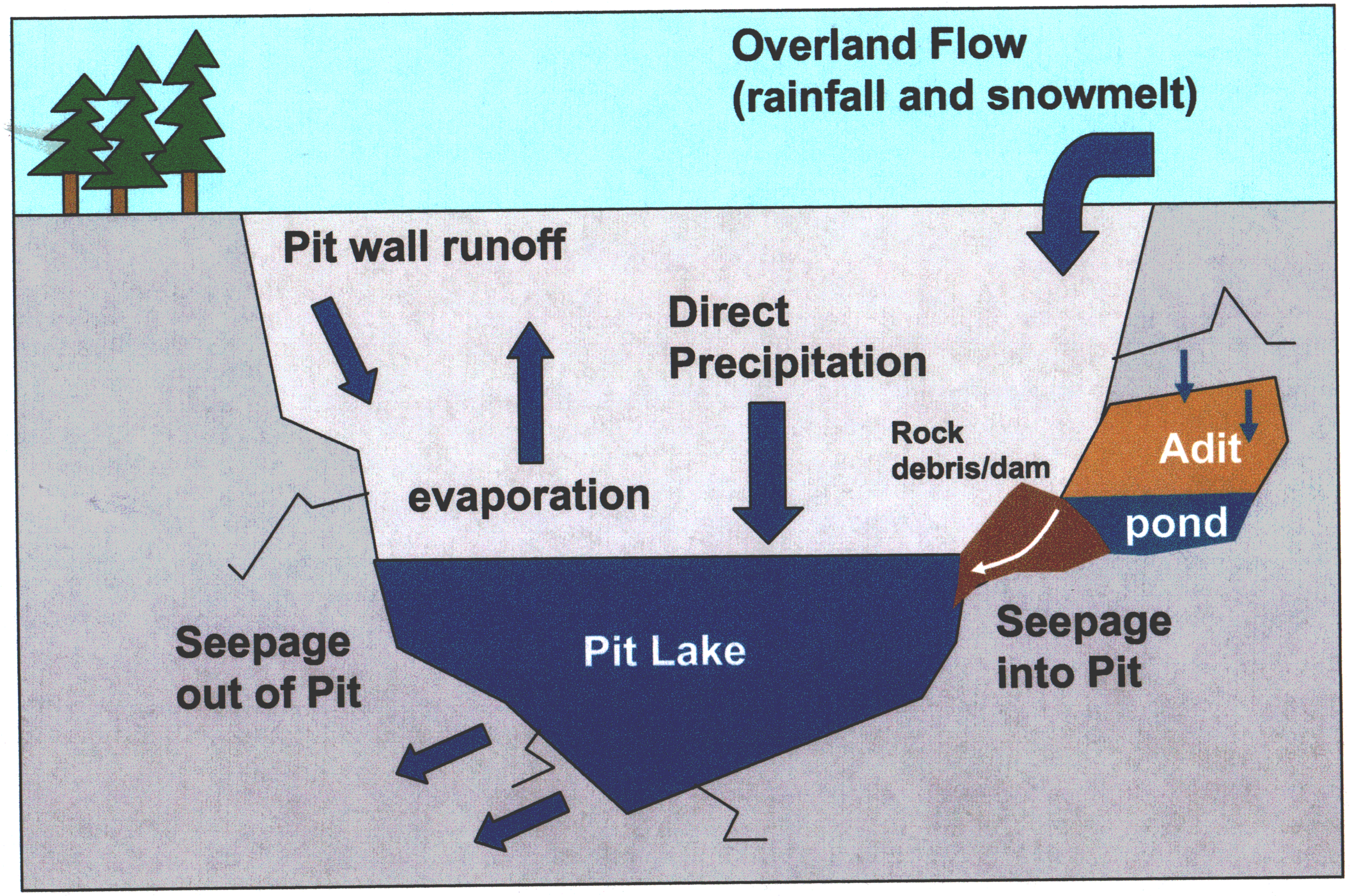

Figure 3. Revised Conceptual Model of Pit Water Balance Showing Seepage of Water into Adit (not Pony Creek Adit) and through soil material and into pit.

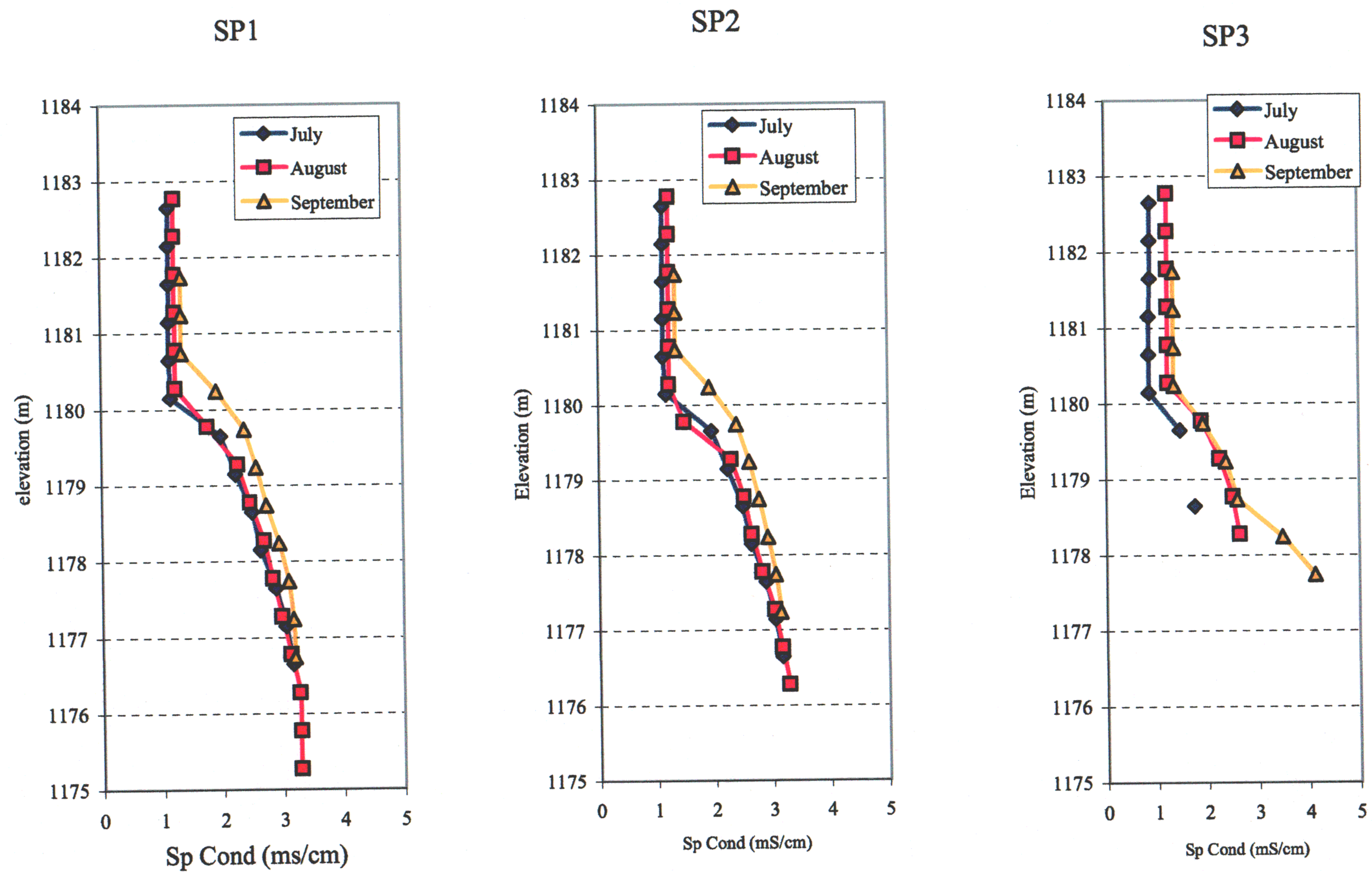

Figure 4. Profiles of Specific Conductance in Pit Lake (2004)

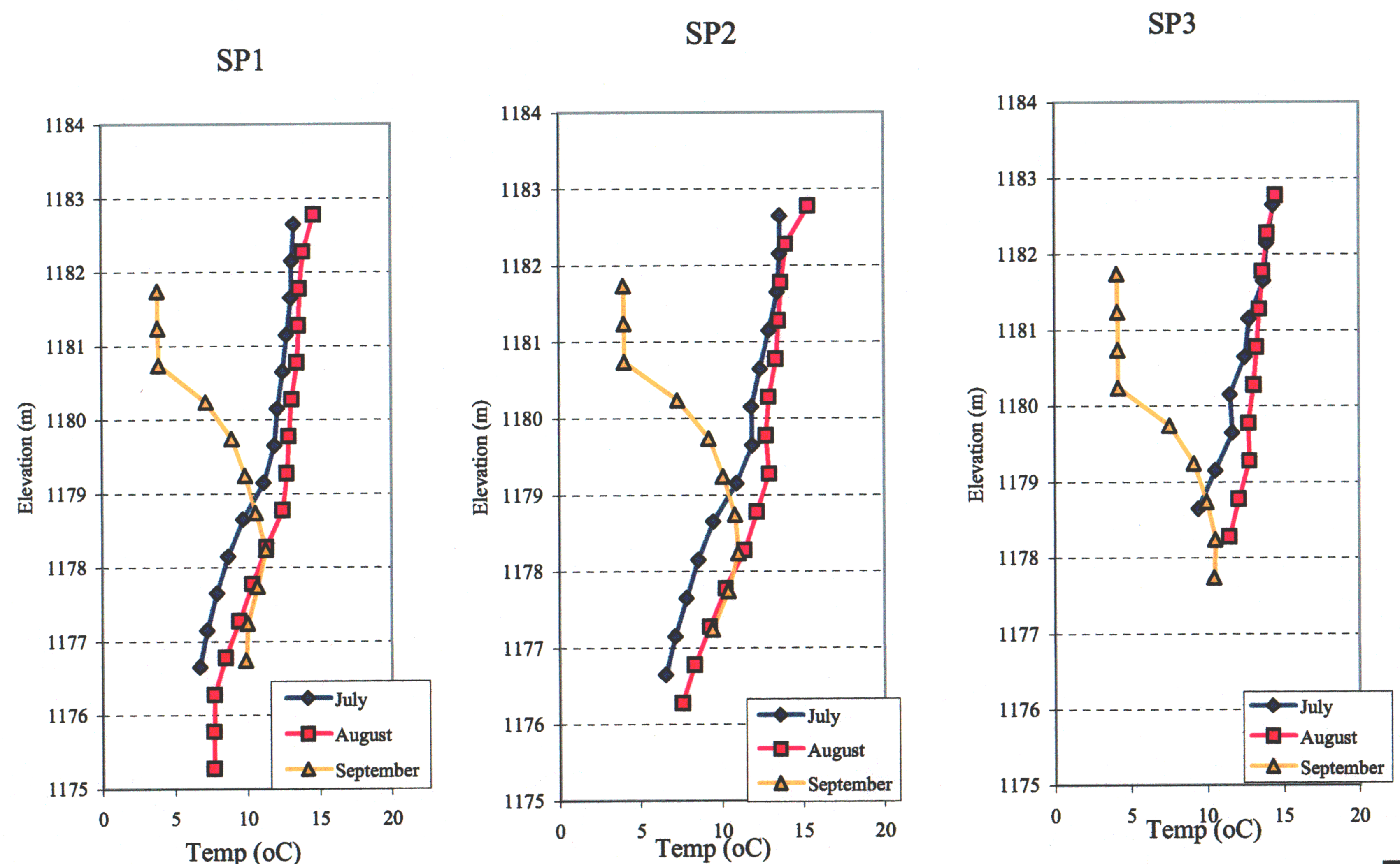

Figure 5. Profiles of Temperature in Pit Lake (2004)

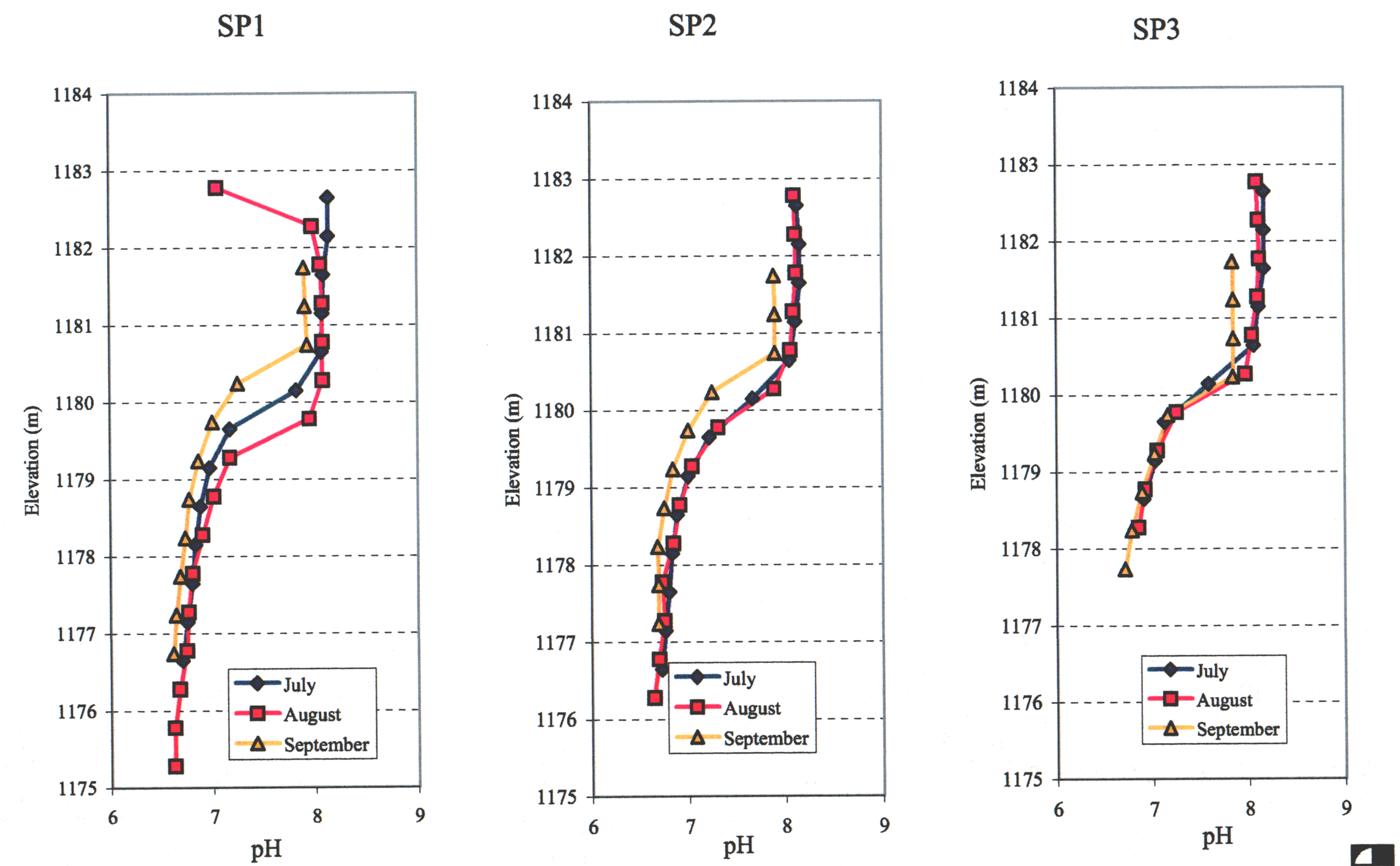

Figure 6. Profiles of pH in Pit Lake (2004)

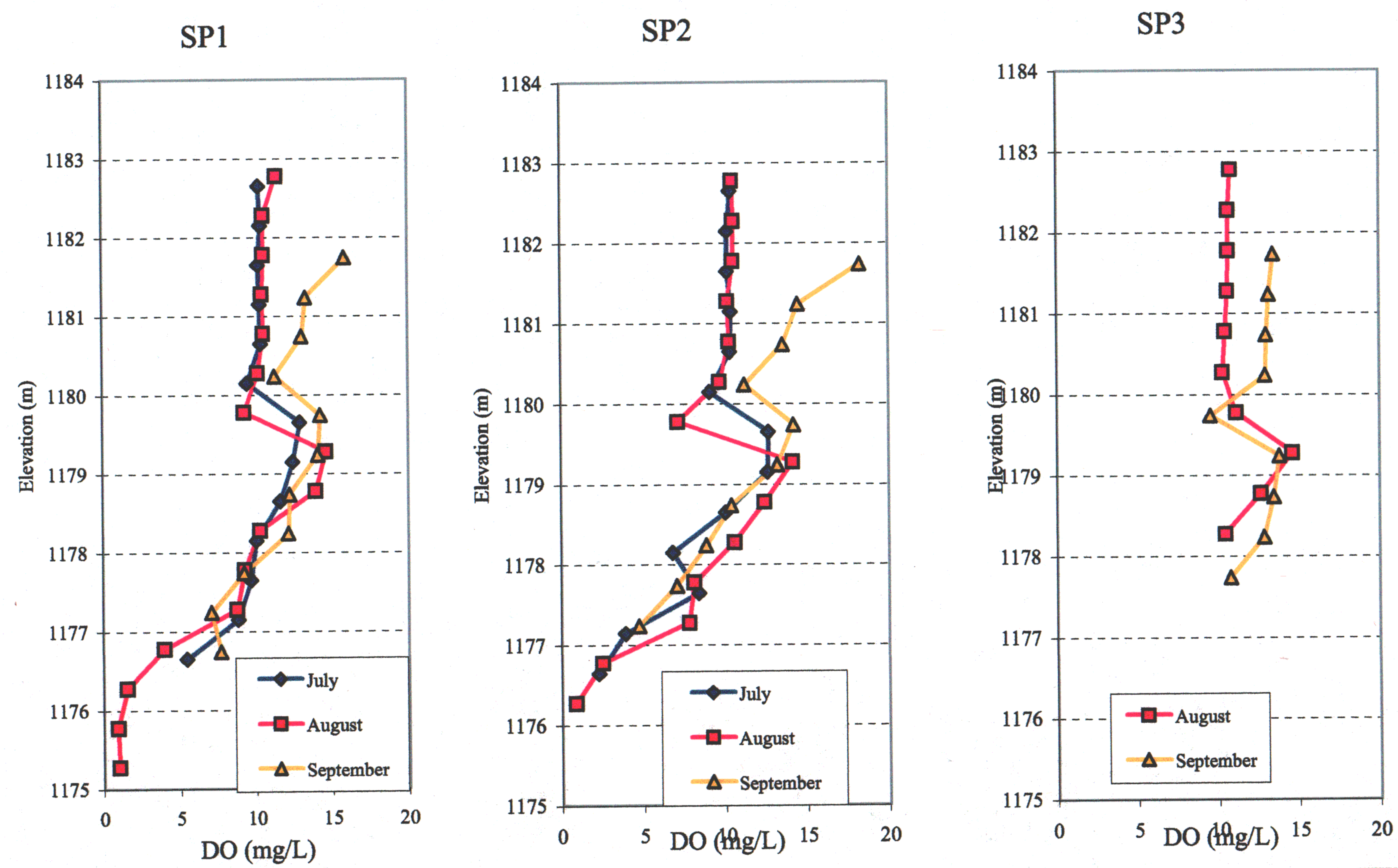

Figure 7. Profiles of Dissolved Oxygen in Pit Lake (2004)