

TECHNICAL MEMO

TO: File

FROM: Mat Weaver, PE

RE: **WR 72-7573 - Hydrologic Analysis of Cyprus Thompson Creek Open Pit Mine**

This memo is a summary of the preliminary hydrologic analysis I performed regarding the Cyprus Thompson Creek open pit mine in association with the licensing of WR permit 72-7573. At the request of Shelley Keen I performed an analysis of the system to determine the relative contributions of surface water and ground water to the mine pit sump.

The open pit mine sits near the top of a mountain in central Idaho that has an elevation of approximately 8,400 feet. The top of the open pit mine is approximately 8,300 feet (100 feet below the top of the mountain). Currently the open pit is between 1,600 – 2,000 feet in depth. The general bedrock geology of the mine consists of a Paleozoic sedimentary rock intruded by Cretaceous igneous rocks (Idaho batholith) partially overlain by a series of Tertiary volcanic rocks (EPA 1993). My review of a series of well logs near the open pit mine supports this general description.

The well consolidated nature of the local bedrock materials creates low porosity, preventing the production of significant amounts of ground water from pore spaces (EPA 1993). The primary sources of ground water to the region include: (1) infiltration of runoff in the surface soils, (2) stream channel underflow within alluvia deposits, and (3) water in fracture and fault zones of bedrock formation (EPA 1993). Due to the physical location of the open pit mine, source (2) does not apply and source (3) is likely extremely limited due to the small amount of surface area located up-gradient from the open pit mine that could contribute subsurface recharge. Therefore, in constructing the following water balance for the mine pit sump, my assumption is that tributary ground water to the system is negligible. I have also assumed the mine pit sump is the low point of the open pit with all runoff discharging to that point.

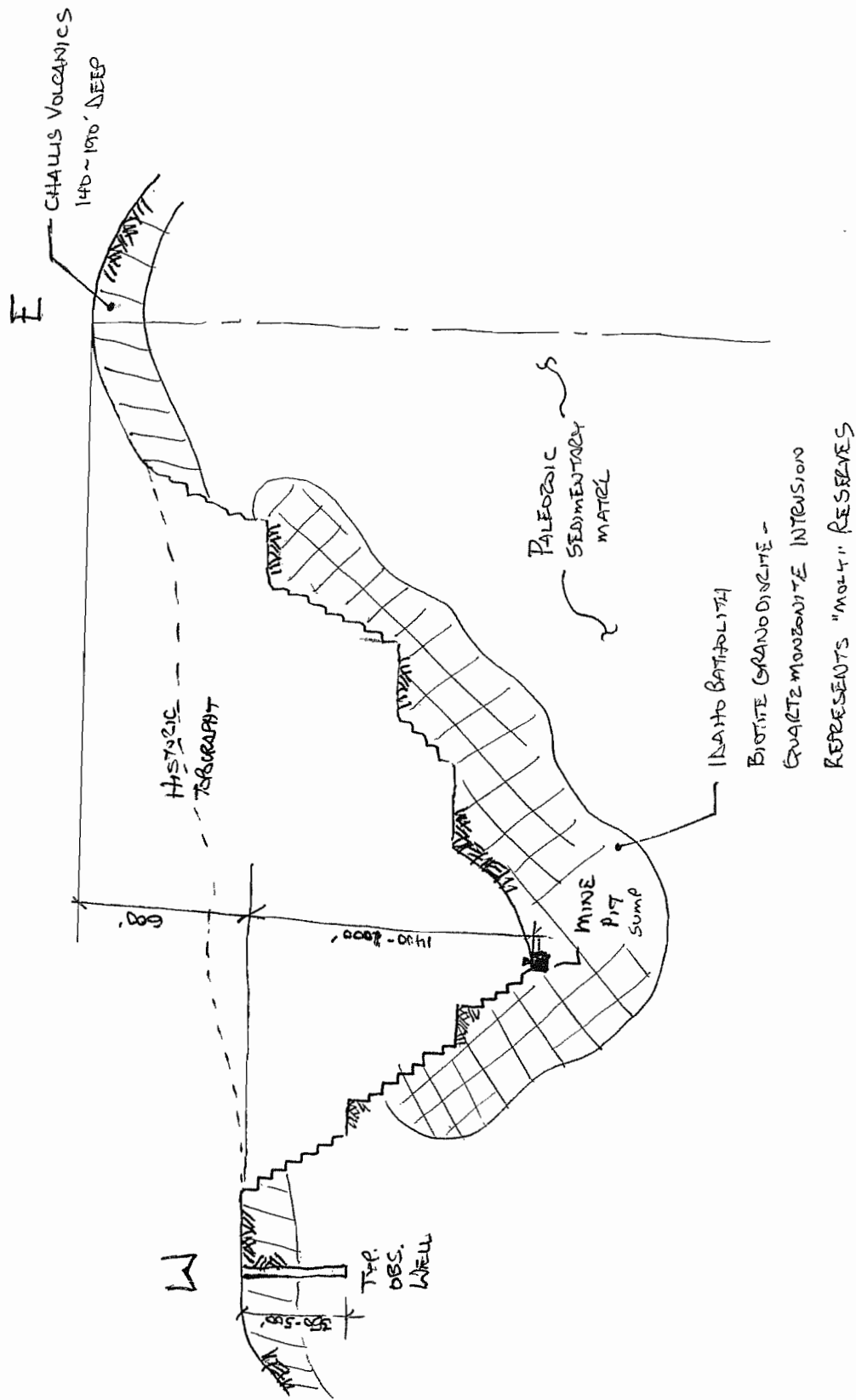
Water Balance: $\Delta S = P + R - ET - Q$, where ΔS equals change in storage, P equals precipitation falling within the areal extent of the open pit, R equals snowmelt runoff within the areal extent of the open pit, ET equals evapotranspiration from bare soil within the areal extent of the open pit, and Q equals pumped diversions from the mine pit sump for beneficial use.

Precipitation is estimated for July, August, and September of 2009 from the National Weather Service station for Stanley, ID (Stanley Rs 04112 SNT). Snowmelt for 2009 was estimated from snow water equivalency data for the NRCS Mill Creek Summit snotel station (Mill Creek Summit 627). ET was estimated using ET_Idaho average monthly data for Stanley, ID (NWS—108676). Finally, diversions from the mine pit sump were obtained from mine operation pumping records.

WB 2009: $\Delta S = 102 \text{ AF} + 1,294 \text{ AF} - 263 \text{ AF} - 487 \text{ AF} = 646 \text{ AF}$

The fact that the change in storage is a positive 646 AF suggests that either the mine sump pit increased in volume during 2009 or water was lost to the subsurface. In either case, the amount of water needed for diversion was completely met by diffuse water. From 2000 to 2009 the minimum snow pack occurred in 2001. Pumping data was not provided for 2001. However, by assuming precipitation and pumping values for 2009 and snowpack data from 2001, change in storage is calculated as -48 AF. This indicates that pumping needs might not be fully met by diffuse water in years with similar snowpack to 2001. However, additional needs of up to 192 AF can currently be met by existing WR 72-7414, which already allows for the diversion of ground water from the mine pit sump.

EPA 1993. Site Visit Report: Cyprus Thompson Creek a report on a site visit conducted by EPA to Cyprus Minerals Corporation's Thompson Creek Molybdenum Mine near Challis, Idaho during 1991. U.S. Environmental Protection Agency (EPA).



X-SECTION
CYPRESS THOMPSON CR OPEN PIT MINE (NTS)

M. Weaver 3/2011

ET_Idaho Actual Evapotranspiration for Bare Soil (Stanley (NWS--108676))

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ET (mm/day)	0.30	0.52	0.60	0.57	0.64	0.73	0.37	0.38	0.33	0.37	0.34	0.20
ET (in/day)	0.01	0.02	0.02	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01
No. Days	31	28	31	30	31	30	31	31	30	31	30	31
ET (in/month)	0.37	0.57	0.73	0.67	0.78	0.86	0.45	0.46	0.39	0.45	0.40	0.24
ET (in/year)	6.40											
ET (ft/year)	0.53											

Open Pit Area Projection:	493	acres
Max. Snowpack SWE:	14.60	inches
Snow Melt Runoff Vol.:	600	AF
Jul Precip:	0.37	inches
Aug Precip:	1.56	inches
Sep Precip:	0.55	inches
Sum:	2.48	inches
Precip Volume:	102	AF
ET Volume:	263	AF

Diffuse Water Vol.:	439	AF
Mine Pit Annual Pumping:	487	AF
WR Volume:	48	AF
2009 Diffuse Water Vol.:	1,133	AF
00-09 Avg. Diff. Water Vol.:	640	AF
2001 Diffuse Water Vol.:	439	AF

Cyprus Thompson Creek Mine Coordination Meeting – 3/7/2011

1. Task: Estimate ground water vs. surface water contribution to mine pit sump
2. Single storm event modeling
 - a. Rational Method
 - b. SCS Curve Number Method
 - c. Drawbacks
 - i. Only valid during summer (3-4 months) b/c system is dominated by snowpack and snow melt runoff
 - ii. Would have to string together a series of storm events from a “typical” year
3. Hydrological Basin Model – BROOK90
 - a. Hydrological model that simulates snow accumulation, soil water, and streamflow from daily precipitation and temperature
 - b. Drawbacks
 - i. Complexity
 - ii. Climate data input
4. Conceptual/Theoretical Water Balance Approach
 - a. $\text{Change in storage} = \text{precip} + \text{snowmelt runoff} - \text{ET} - \text{pumping} - \text{subsurface flow}$
 - b. Conceptual model of basin suggests subsurface flow is negligible
 - c. If we assume subsurface flow is zero then recharge makes up entire input to basin
 - i. Does this make sense? Maybe.
5. Conclusions
 - a. All water is diffuse therefore no water right needed
 - b. All water is not diffuse all the time, but it is dominated by diffuse water, therefore change source of water right to surface water and ground water and issue.