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August 21, 1991

Mr. Steve Tanner
Valley Camp of Utah Inc.
Scofield Route
Helper, Utah 84526

RE: Peak Runoff and Flow Evaluation.

Dear Steve:

As requested we are submitting to you a letter describing our evaluation of recent runoff events which impacted the Valley Camp and neighboring areas. As per your phone call on August 14th, it was your belief that Valley Camp received a rainfall event on August 2nd which exceeded the design event for the Belina runoff facilities as required by the Utah Division of Oil, Gas & Mining and OSM. Information received from you by phone that day related to damage noted and preliminary high water marks appeared to indicate that indeed such was the case. A site visit made on the 15th confirmed information received by phone.

Areas reviewed during the site visit include locales adjacent to culverts C-25-36, C-28-24, C-34-24, and C-44-24. Time limitations prevented the review of other areas and culverts. Attempts to identify recent flows through each of these culverts were made so that the magnitude of the event could be compared with the design event for the respective area. A design flow exceedence at any one site indicates a corresponding runoff exceedence in the general locale. To clarify conditions and simplify conclusions reached at each site, each finding has been separated in the following table. Supporting calculations are attached.

FINDINGS OF CULVERT FLOW INVESTIGATION

CULVERT NO.	DESIGN FLOW (cfs)	CALCULATED FLOW (cfs)	COMMENT
C-25-36	7.0	32.0 <	High water level was determined through debris caught in tear in top of culvert inlet. **Design flow exceeded by 455%.**

CULVERT NO.	DESIGN FLOW (cfs)	CALCULATED FLOW (cfs)	COMMENT
C-28-24	3.3	8.2	High water level was determined by debris remnants. Culvert was partially plugged. Equivalent culvert size was determined and head water depth was reduced from 4.5 feet to 3.5 feet to account for plugging impacts. **Design flow exceeded by 250%.**
C-34-24	2.5	21.0	Debris caught on stick marked high water line. Flow was actually greater over road, but debris mark was taken as conservative high water level. Flow estimate was also reduced by 20% to account for additional entrance losses caused by bent culvert inlet. **Design flow exceeded by 840%.**
C-44-24	2.5	24.9	Water Level (marked by sediment and debris) in pipe at discharge end was used to calculate a peak flow using Mannings equation. **Design flow exceeded by 995%.**
	2.5	29.0	Flow calculated using Mannings equation for this stream channel Cross Section (Section #1) located approximately 27 feet upstream of the culvert inlet. **Design flow exceeded by 1160%.**
	2.5	28.4	Flow calculated using Mannings equation for this stream channel Cross Section (Section #2) located approximately 14-15 feet upstream of Cross Section #1. **Design flow exceeded by 1135%.**

From information presented in the preceding table it appears that the design event was indeed exceeded within the recent past. Debris markings which were noted at each location were relatively fresh and indicated the presence of high water as noted above. The rainfall event noted to have occurred at the Coastal States mining operation (an approximate 0.75 inch rainfall in 20 minutes as we understand it) would have exceeded the 10 Year, 6 Hour design storm for the surface facilities at the Belina Mine. The relatively heavy rainfall and short duration of the

August 2nd event appears to have prevented the infiltration of rainfall into local soils thereby increasing overall local runoff.

Should you have any questions please call.

Sincerely,

David E. Hansen, Ph.D., P.E.
Principal

cc: Rick Summers - DOGM

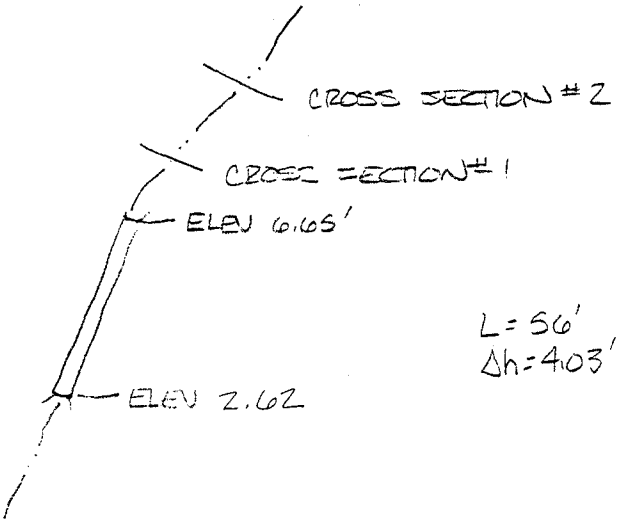
DEH/dh

Check/Evaluation of Flood Flows

C-44-24

Schematic

design Q = 2.5 cfs



Bump exists at mid culvert, however, approximate normal flow will be reached near culvert outfall

Water level at outfall (± per debris) = 1.3'

Using Mannings Equation: $n = 0.024$, $S = \frac{4.03}{56} = 0.072$

NOTE: Slope is Average, last ½ of pipe is steeper than 0.72 ft/ft

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} = 24.9$ cfs => 2.5 cfs designed

Exceedence by ≈ 10 times

Check Using Cross Sections (See Attached Printouts)

Section 1 Q = 28.97 cfs
Section 2 Q = 28.36 cfs

Relatively close match to est. made above

Above est. based on Pipe flow is probably low because of higher slope noted in lower part of pipe which was not accounted for in equation and also because of potentially artificially low water level at exit.

Valley Camp Cross Sections
15 Aug 1991
002.13.100

X-Section 1

High Water = 1.92
Mannings n = 0.024
Slope = 0.0372

X Dist	Y Dist	Depth	Area	Perimeter
-0.40	1.92	0.00		
0.00	2.21	0.29	0.06	0.49
0.50	2.34	0.42	0.18	0.52
1.00	2.74	0.82	0.31	0.64
1.50	2.72	0.80	0.41	0.50
2.00	2.70	0.78	0.40	0.50
2.50	2.63	0.71	0.37	0.50
3.00	2.51	0.59	0.33	0.51
3.50	2.50	0.58	0.29	0.50
4.00	2.50	0.58	0.29	0.50
4.50	2.45	0.53	0.28	0.50
5.00	2.48	0.56	0.27	0.50
5.50	2.44	0.52	0.27	0.50
6.00	2.34	0.42	0.24	0.51
6.50	2.24	0.32	0.19	0.51
7.00	2.18	0.26	0.15	0.50
7.50	2.11	0.19	0.11	0.50
8.00	1.97	0.05	0.06	0.52
8.50	2.07	0.15	0.05	0.51
9.00	2.06	0.14	0.07	0.50
9.50	2.05	0.13	0.07	0.50
10.00	2.06	0.14	0.07	0.50
10.50	2.07	0.15	0.07	0.50
11.00	2.08	0.16	0.08	0.50
11.50	1.92	0.00	0.04	0.52
	2.29	0.37	4.63	12.26

Mannings Equation Q=(1.49AR^(2/3)S^(1/2))/n

(Q) = 28.97 cfs

X-Section 2

High Water = 1.21
Mannings n = 0.024
Slope = 0.0372

X Dist	Y Dist	Depth	Area	Perimeter
0.00	1.21	0.00		
1.00	1.71	0.50	0.25	1.12
1.50	1.71	0.50	0.25	0.50
2.00	1.73	0.52	0.26	0.50
2.50	1.63	0.42	0.24	0.51
3.00	1.72	0.51	0.23	0.51
3.50	1.69	0.48	0.25	0.50
4.00	1.72	0.51	0.25	0.50
4.50	1.84	0.63	0.29	0.51
5.00	2.12	0.91	0.39	0.57
5.50	2.20	0.99	0.48	0.51
6.00	2.00	0.79	0.45	0.54
6.50	1.63	0.42	0.30	0.62
7.00	1.39	0.18	0.15	0.55
7.50	1.21	0.00	0.09	0.53
			3.85	7.98

Mannings Equation Q=(1.49AR^(2/3)S^(1/2))/n

(Q) = 28.36 cfs

C-28-24 design Q = 3.3 cfs

Headwater Appears to be at approx 4.5 ft total depth

Assume HW depth of only 3.5 ft (Bottom half of Culvert is plugged from debris resulting from Storm) - Find equivalent pipe size and check flow estimate

$A_{24} = \frac{\pi (2)^2}{4} = 3.14 ft^2$ $\frac{A_{24}}{2} = 1.57 ft^2 = \frac{\pi}{4} D'^2$ $D' = 1.41 ft = 17 in$

Assume 15" CMP $\frac{HW}{D} = \frac{3.5}{1.25} = 2.8$

from Nomograph, Q = 8.2 cfs

8.2 cfs > 3.3 cfs design

Exceedence by ~ 2.5 times

C-34-24 design Q = 2.5 cfs

Min Headwater depth noted (debris swirls) = 5.2'
ditches overflowed which add to 5.2' depth

HW/D = 5.2/2.0 = 2.6

from Nomograph Q = 26 cfs

Reduce 20% for additional entrance losses. gives:

Q ≈ 21 cfs >> 2.5 cfs design

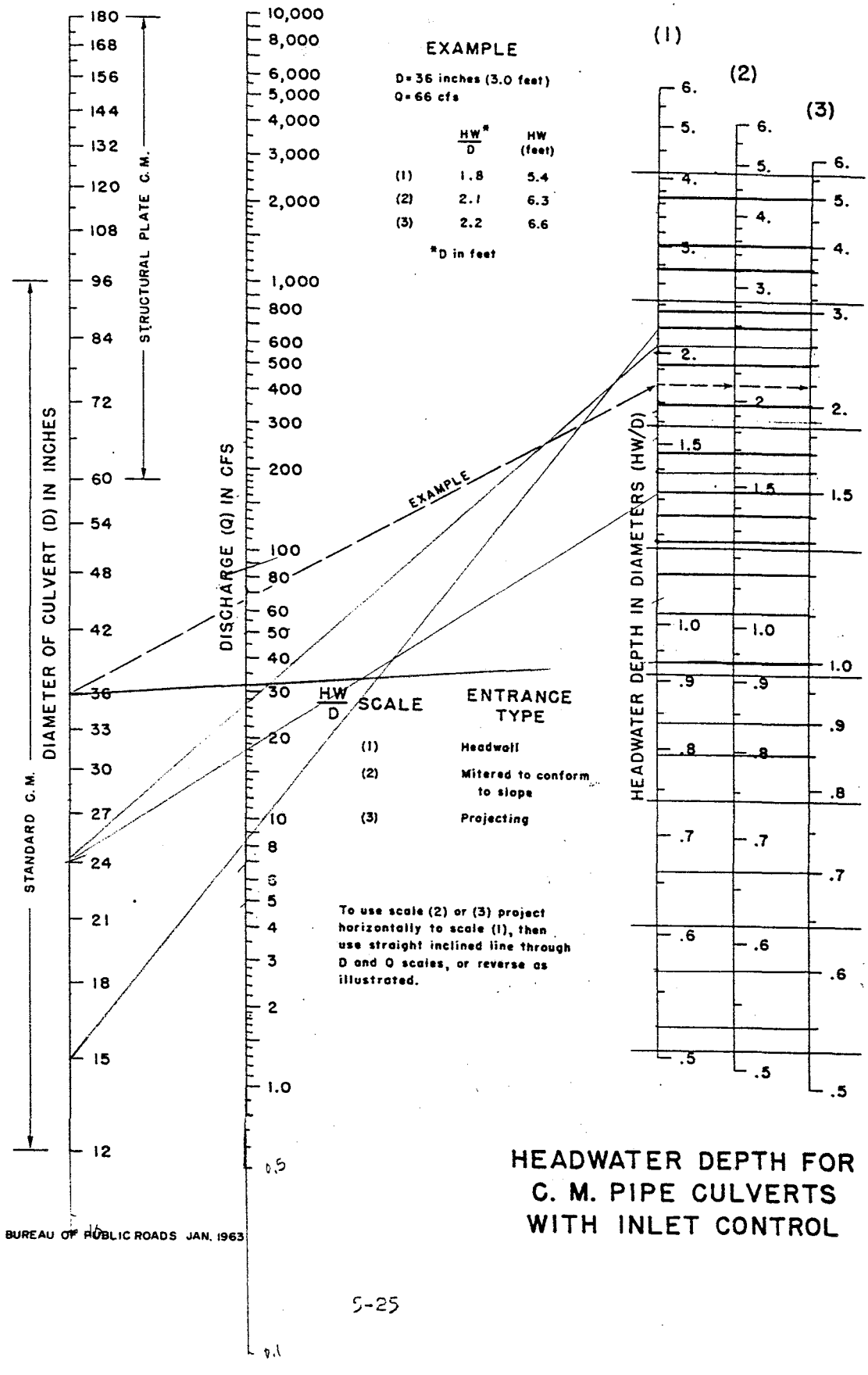
Exceedence by ~ 8.5 times

C-25-36 Straw caught in top of culvet where form.

HW/D ≥ 1.0 from Nomograph, Q ~ 32 cfs >> 7.0 cfs design

Exceedence by ~ 4.5 times

CHART 5



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HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL