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#2

July 25, 1983

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DIVISION OF
OIL, GAS & MINING

Mr. Tom Munson, Hydrologist
Utah Division of Oil, Gas and Mining
4241 State Office Bldg.
Salt Lake City, Utah 84114

Dear Mr. Munson:

This letter is in response to our phone converstaion of July 19 concerning completeness question (i) on page 5 of the June 9, 1983 "Determination of Completeness and Technical Deficiencies" for the Beaver Creek Coal Company, Gordon Creek No. 2 Mining and Reclamation Plan. This letter provides the basis for the use of various curve numbers for flow estimation at both the Gordon Creek No. 2 mine and the new southwest lease facilities expansion associated with the Gordon Creek site.

Curve Numbers (CN) listed on page 7-61 of the Gordon Creek No. 2 MRP were obtained from estimates in the previous MRP submittals. The original source of the estimates is unknown but values used in the analyses are considered representative of vegetation and soil cover conditions for the Bryner Canyon watershed.

The Curve Number (CN) is a dimensionless coefficient which reflects cover conditions, soil hydrologic type, land use and antecedent moisture. The Curve Number is used in the SCS method to relate storm rainfall to storm runoff volume. Although Curve Numbers can be estimated from various technical manuals, considerable professional judgement is needed to apply the method. Lack of accurate daily rainfall and runoff data prevents local verification of estimated Curve Numbers.

The USBR (1977) has modified the SCS method for design of small structures. Estimates were developed following the procedures described in Appendix A of USBR (1977).

In the forest-range regions of the western United States, soil group, cover type and cover density are factors used in estimating CN. Figure 7 shows the relationship between these factors and CN for hydrologic soil groups B and C.

Based on the 1980 vegetation survey, drainage areas A and B consist of about 55% oakbrush and aspen and 39% sage-grassland. The remaining 10% of the basin consists of mixed conifers. Ground cover densities for the two dominant vegetation complexes are approximately 93% for the oak-aspen complex and 40% for the sage-grassland complex. Soils are either hydrologic soil group B or C. Curve number estimates for the dominant vegetation cover complexes were determined from Figure 7 (USBR(1977) p. 539). The curve numbers for oak-aspen and sage-grassland complexes are 37 and 68 respectively. The area weighted curve number for the two dominant cover complexes is 49. While this curve number is seemingly low, it should be noted that initial abstractions and infiltration rates are extremely high in the thick oak brush cover.

Alternative estimates for curve number can be developed using other tabulated values. For instance, a curve number of 70 is obtained for wood or forest land with good cover and hydrologic soil group C from Table 2 in McCuen (1982). The comparable Curve Number for soil group B is 55. These tabulated values exhibit large changes with soil group but relatively small changes with cover conditions while the values in Figure 7 are quite sensitive to cover condition.

Based on both measured and observed flow in Bryner Canyon, it appears that the curve number of 54 previously used for undisturbed areas is a reasonable estimate for this basin. Flows are extremely rare. During some years flow is never observed. Even with the rainfall events during the snowmelt runoff period of 1983, flows were considerable less than the discharge of 3.8 cfs used for diversion design at Gordon Creek No. 2 mine.

A curve number of 63 for undisturbed areas was selected for design use at the southwest lease facilities area. This represents the curve number from Table 2 in McCuen (1982) for forest and woods with soils from both soil group B and C as found at the site. Also, it provides higher design flows than would be obtained using the curve number of 49 as derived from the procedures in USBR(1977). Curve numbers for reclaimed areas for hydrologic soil group C are based on estimates in OSM (1981). Values are given in the range 74-88. A value of 80 was used. For disturbed areas including active mine areas and surface facilites, estimates in OSM (1981) range from 87 to 98. A value of 90 was used because of the lack of paved surfaces and minimal impervious area found at the mine site.

The Fletcher-Farmer rainfall distribution is contained in "Storm-Hydrograph Program" Final Report to Utah Division of Oil, Gas and Mining, September 1979. This distribution was inserted in the TR-20 program as a user supplied rainfall distribution. The distribution was derived by E. E. Farmer and J. E. Fletcher, (1972) for the Wasatch Plateau region of Utah.

I expect that this letter answers your questions concerning methodologies used to estimate flows for design purposes at Gordon Creek No. 2 mine. Of course, the true test for any design is the test of time. The drainage controls at Gordon Creek No. 2 Mine have past this test. The ditches and culverts have had ample capacity for all flows to date, including the runoff during the extreme snowmelt period of June, 1983. Should you have any further questions, please call me at (303)575-7610.

Sincerely,

Arthur P. O'Hayre
Hydrology Advisor

APO:nc

Attachments

cc: D. Guy
S. Raymond

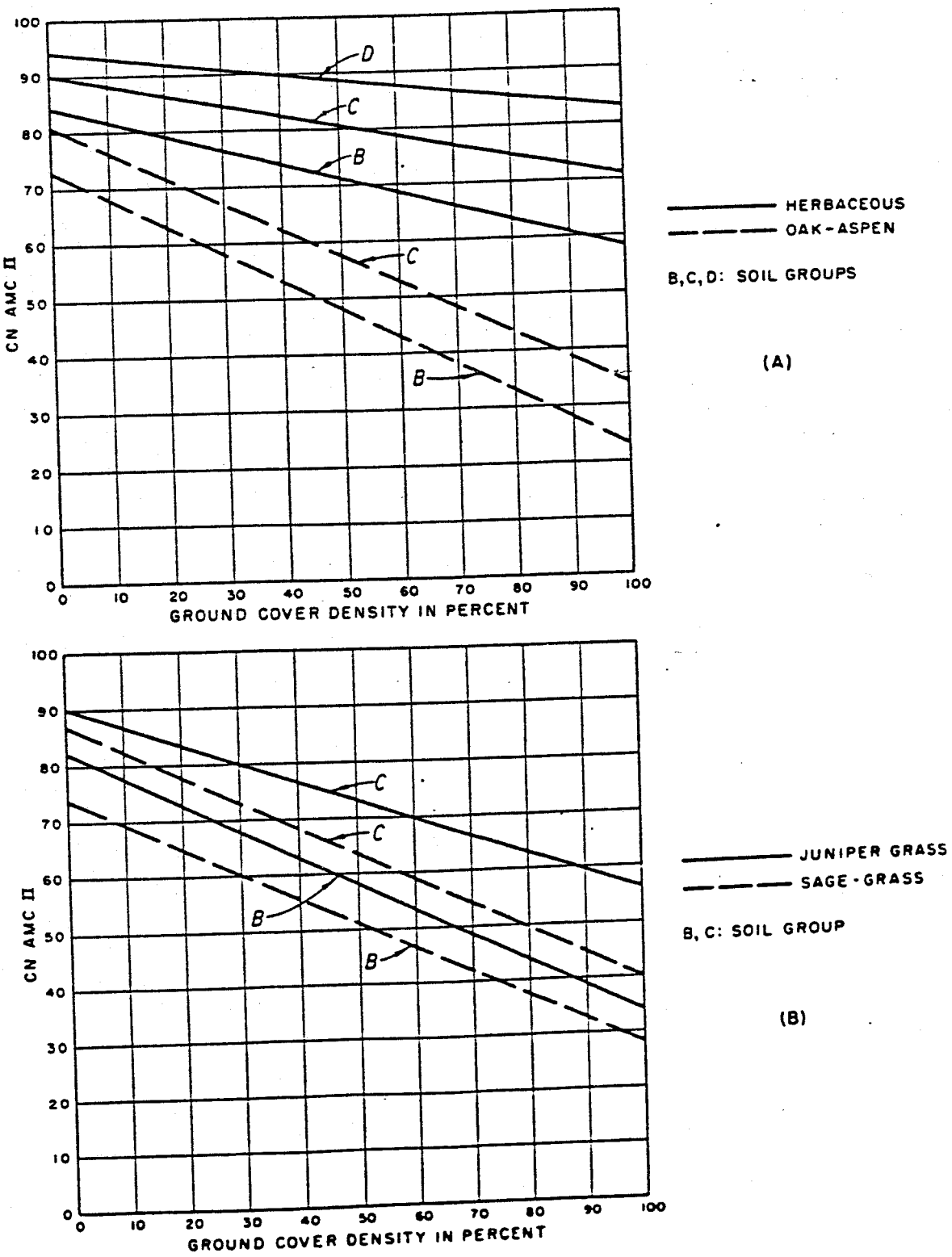

Figure 7 Determining CN for forest-range in the western United States (from USBR, 1977).

TABLE 2. Runoff Curve Numbers for Hydrologic Soil-Cover Complexes
(Antecedent Moisture Condition II, and $I_a = 0.2\ S$)

Land Use Description/Treatment/Hydrologic Condition			Hydrologic Soil Group			
			A	B	C	D
Residential:[1]						
Average lot size	Average % Impervious[2]					
1/8 acre or less	65		77	85	90	92
1/4 acre	38		61	75	83	87
1/3 acre	30		57	72	81	86
1/2 acre	25		54	70	80	85
1 acre	20		51	68	79	84
Paved parking lots, roofs, driveways, etc.[3]			98	98	98	98
Streets and roads:						
paved with curbs and storm sewers[3]			98	98	98	98
gravel			76	85	89	91
dirt			72	82	87	89
Commercial and business areas (85% impervious)			89	92	94	95
Industrial districts (72% impervious)			81	88	91	93
Open Spaces, lawns, parks, golf courses, cemeteries, etc.						
good condition: grass cover on 75% or more of the area			39	61	74	80
fair condition: grass cover on 50% to 75% of the area			49	69	79	84
Fallow	Straight row	---	77	86	91	94
Row crops	Straight row	Poor	72	81	88	91
	Straight row	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	Contoured	Good	65	75	82	86
	Contoured & terraced	Poor	66	74	80	82
	Contoured & terraced	Good	62	71	78	81
Small grain	Straight row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	Contoured & terraced	Poor	61	72	79	82
		Good	59	70	78	81
Close -seeded legumes[4] or rotation meadow	Straight row	Poor	66	77	85	89
	Straight row	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	Contoured	Good	55	69	78	83
	Contoured & terraced	Poor	63	73	80	83
	Contoured & terraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
	Contoured	Fair	25	59	75	83
	Contoured	Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods or Forest land		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		---	59	74	82	86

[1] Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

[2] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

[3] In some warmer climates of the country a curve number of 95 may be used.

[4] Close -drilled or broadcast.

REFERENCES

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