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# of Pages: 8, including this cover sheet.

Date: 9-16-02

Please look over these revised sediment yield calculations for Sowbelly Canyon and determine whether I have addressed your concerns adequately.

Thank you

From: Layne Jensen

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Phase II Bond Release Sediment Yield Calculation
- Sowbelly Canyon -

The purpose of these calculations is to demonstrate that the reclaimed areas in Sowbelly Canyon will generate the same amount of or less sediment than the same site assuming undisturbed conditions.

To do this the Revised Universal Soil Loss Equation ("RUSLE) will be used.

Although the vegetation at the reclaimed site is fairly uniform there are other factors which affect the sediment yield for the sites. For example not all of reclaimed area was gauged. To account for the variation the sediment yield will be calculated under four conditions.

1) Assume the reclaimed area under undisturbed conditions. The site is Pre-SMCRA and good Pre-mining topo does not exist thus, the reclaimed slopes will be used since pre-mining slopes are unavailable. However, this will result in an overall conservative estimate since natural slopes are generally steeper (more erosive) than the reclaimed slopes,

2) Worst case in gauged area

3) Ave sediment yield in gauged areas.

4) Sediment yield in non gauged areas.

$$A = R \cdot K \cdot LS \cdot C \cdot P$$

A = Sediment yield (tons/acre/yr)

R = Rainfall Runoff erosivity factor (-)

K = Soil erodibility factor (-)

LS = Length-slope factor (-)

C = Cover management factor

P = Support practice factor.

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Rainfall factor (R)

This factor will be the same for all four conditions.

R = 11 (Map R7 : Israelsen et. al. (1984)

Soil erodibility factor (K)

This factor is the same for all four conditions.

Soil samples taken near the surface in Appendix 3.2B give an average gradation of

Sand = 43%
Silt = 36%
Clay = 21%

The nomograph to be used to determin K needs the percentage of silt and very fine sand. However, no analysis for very fine sand was made. Therefore Assume 5% very fine sand

OM = 1.6%
└ Ave of 6 samples analyzed by imal in 1993 (Appendix 3.2B)

Assume Silt + very fine sand = 41%
Sand = 38%

K = 0.26

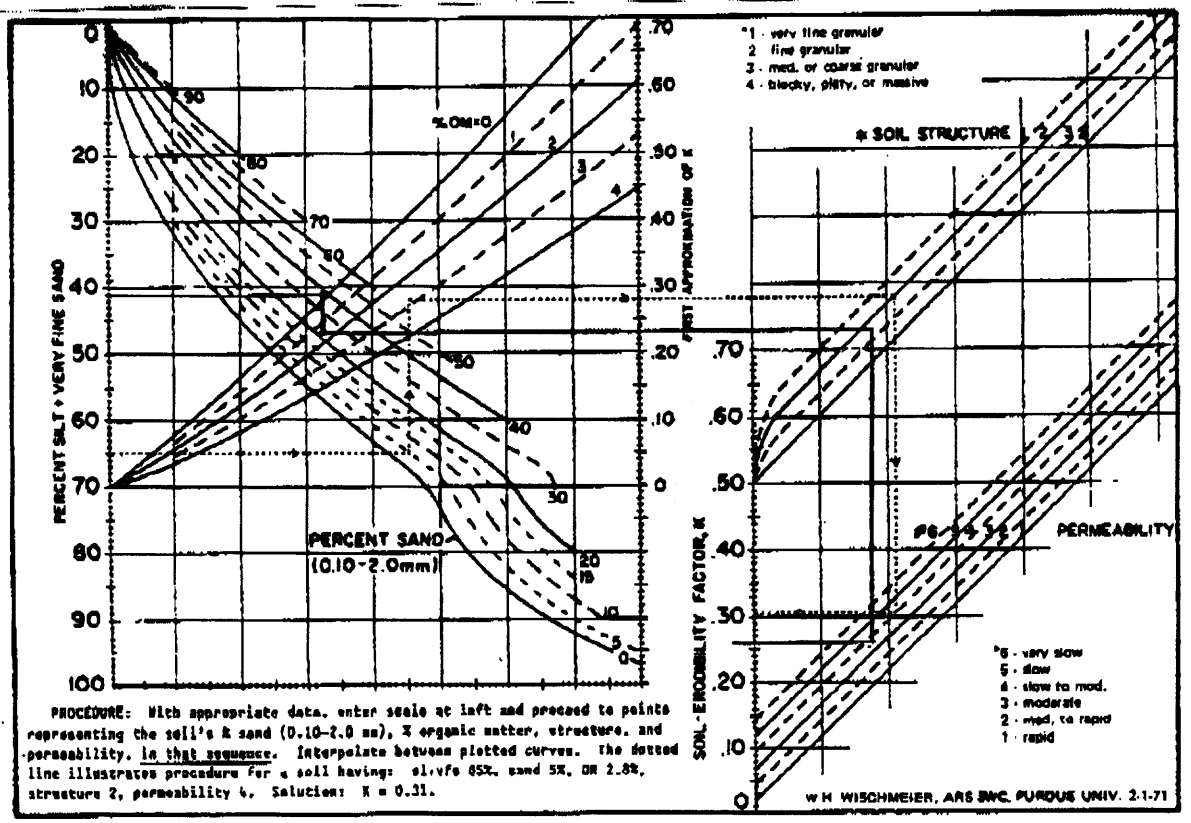

Figure 2. Nomograph for determining soil erodibility factor K.

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Length - slope factor (LS)

The average slope for the reclaimed area can be calculated using the equation Ave slope = (Contour length)(contour interval)/(Area)

$$\text{Ave slope} = \frac{(13,750\ \text{ft})(10\ \text{ft})}{792,792} = 0.173$$ round up to a slope of 20%

The Length will vary for each of the four conditions. The length is the distance water travels before reaching an established channel or something that stops the flow such as a berm or depression.

Condition 1

The average flow distance over the disturbed area is Approximately 150'

$L = 150$

$LS = 5.0$ Table 4-1 Renard et.al (1997)

Condition 2

During a site visit the greatest distance water could flow before hitting a depression is 45'

$L = 45'$

$LS = 2.74$ Table 4-1 Renard et.al (1997)

Condition 3

The average distance between depressions in the ganged area is 20'

$L = 20'$

$LS = 1.82$ Table 4-1 Renard et.al. (1997)

Condition 4

The maximum flow distance over reclaimed non ganged areas is 120'

$L = 120'$

$LS = 4.47$

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Cover Management factor (C)

Reference area

Vegetative Cover = 49.25

of the vegetation cover
grasses = 59.6 %
shrubs = 22.7 %
forbs = 17.7 %

Litter = 21.75 %
Rock = 18.30 %
Bareground = 10.70 %

Total Cover = 89.3 %

Reclamation Area

Vegetative Cover = 47.44 %

Grasses = 52.79
Forbs = 37.16
Shrubs = 10.06

Litter = 11.65
Rock = 15.88
Bareground = 25.04

Total cover = 74.96 %

Condition 1 (Assume reference area conditions)

Cover that contacts the surface = 49.25 + 18.30 = 67.6 % *

C = 0.031 Interpolated from Table 8B.2 (Pg 6) No appreciable canopy

Condition 2-4

Cover that contacts the surface = 47.44 + 15.88 = 63.3 %

C = 0.037 Table 8B.2 (Pg 6)

* Table 8B.2 Assumes that litter is only considered to be ground cover if the litter is over 2" deep. Which is not the case here.

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Support Practice (P)

The support practice factor accounts for the regular working or tillage of the soil. Since the reclaimed area is to be left undisturbed. This factor of the RUSLE is not applicable to this site.

∴ P = 1 for all conditions.

Summary

Condition	R	K	LS	C	P	A (tons/acre/yr)
1	11	0.26	5.0	0.031	1	0.44
2	11	0.26	2.74	0.037	1	0.29
3	11	0.26	1.82	0.037	1	0.19
4	11	0.26	4.47	0.037	1	0.47

The gouged areas produce less sediment than the undisturbed areas. Until the litter builds up with more growing seasons the non-gouged areas produce a little more sediment. However, as shown on Exhibit 3.2-13 the non gouged areas are a small part of the total reclamation. Also, Runoff from non-gouged areas must flow through gouged areas. Thus the runoff will be stopped by the depressions and any additional sediment will drop out in the depression.

Total Reclaimed area = 18.2 acres
Total gouged = 14.47 acres
Total non-gouged = 3.73 acres.

Sediment yield assuming condition 1 = (0.44 X 18.2) = 8.01 tons/yr

Sediment yield from gouged area with Ave spacing = (0.19)(14.47) = 2.75 tons/yr

Sediment yield assuming condition 4 = (0.47 X 3.73) = 1.75 tons/yr

Undisturbed = 8.01 tons/yr > Reclaimed = 4.50 tons/yr

3.51 tons/yr less sediment generated by reclaimed site.

Table 88.2 *C* Factors for Permanent Pasture, Rangeland, Idle Land, and Grazed Woodlands (after Wischmeier and Smith, 1978)[a]

Vegetal canopy			Cover that contacts the surface Percentage ground cover					
Type and height of raised canopy[b]	Canopy cover (%)	Type[d]	0	20	40	60	80	95–100
No appreciable canopy		G	0.45	0.20	0.10	0.042	0.013	0.003
		W	0.45	0.24	0.15	0.090	0.043	0.011
Canopy of tall weeds or	25	G	0.36	0.17	0.09	0.038	0.012	0.003
short brush (0.5-m fall height)		W	0.36	0.20	0.13	0.082	0.041	0.011
	50	G	0.26	0.13	0.07	0.035	0.012	0.003
		W	0.26	0.16	0.11	0.075	0.039	0.011
	75	G	0.17	0.10	0.06	0.031	0.011	0.003
		W	0.17	0.12	0.09	0.067	0.038	0.011
Appreciable brush or bushes	25	G	0.40	0.18	0.09	0.040	0.013	0.003
(2-m fall height)		W	0.40	0.22	0.14	0.085	0.042	0.011
	50	G	0.34	0.16	0.085	0.038	0.012	0.003
		W	0.34	0.19	0.13	0.081	0.041	0.011
	75	G	0.28	0.14	0.08	0.036	0.012	0.003
		W	0.28	0.17	0.12	0.077	0.040	0.011
Trees, but no appreciable	25	G	0.42	0.19	0.10	0.041	0.013	0.003
low brush (4-m fall height)		W	0.42	0.23	0.14	0.087	0.042	0.011
	50	G	0.39	0.18	0.09	0.040	0.013	0.003
		W	0.39	0.21	0.14	0.085	0.042	0.011
	75	G	0.36	0.17	0.09	0.039	0.012	0.003
		W	0.36	0.20	0.13	0.083	0.041	0.011

[a]All values shown assume: (1) random distribution of mulch or vegetation and (2) mulch of appreciable depth where it exists. Idle land refers to land with undisturbed profiles for at least a period of 3 consecutive years. Also to be used for burned forest land and forest land that has been harvested less than 3 years ago.

[b]Average fall height of waterdrops from canopy to soil surface in meters.

[c]Portion of total surface area that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

[d]G, cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 in. deep. W, cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral root network near the surface) and/or undecayed residue.

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