

Station: Niobrara River near Cody, Nebr.

Section: C-2

Date: June 19, 1952

Preliminary data and computations

$w = 118$  ;  $\bar{u} = 2.08$  ;  $d = 0.98$  ;  $d_s = 1.22$  ;  $D_{65}(k_s) = 0.00105$  ;  $D_{35} = 0.00075$  ;  $\text{Conc.} = 262$  ;  $Q_{SM} = 163$  ;  $\text{Temp.} = 64^\circ\text{F}$   
 $\bar{u} = 5.75\sqrt{(SR)_m} \sqrt{g \log_{10} \frac{12.27 dx}{k_s}}$  ;  $\sqrt{(SR)_m} = \frac{2.08}{32.6 \log_{10} \frac{12.27(0.98)(1.54)}{(0.00105)}} = 0.0150$  ;  $(SR)_m = 0.000225$  ;  $u_m = \sqrt{(SR)_m g} = 0.0853$   
 $\delta = \frac{11.6V}{u_m} = \frac{11.6(1.14 \times 10^{-5})}{(0.0853)} = 0.00155$  ;  $\frac{k_s}{\delta} = \frac{(0.00105)}{(0.00155)} = 0.68$  ;  $x = 1.54$  ;  $P = 2.303 \log_{10} \frac{30.2 dx}{k_s} = 2.303 \log_{10} \frac{30.2(0.98)(1.54)}{(0.00105)} = 10.7$   
 $A' = d_n/d_s = \frac{0.3}{1.22} = 0.246$  ; Percent of flow in sampled zone = 80 ; load in sampled zone ( $Q'_{ts}$ ) = 130

Computation of  $i_B Q_B$

| (1)    | (2)      | (3)        | (4)           | (5)   | (6)       | (7)   | (8)       |
|--------|----------|------------|---------------|-------|-----------|-------|-----------|
| D      | $\psi_m$ | $\Phi^*/2$ | $1200D^{3/2}$ | $i_b$ | $i_B Q_B$ | 43.2w | $i_B Q_B$ |
| .00058 | 5.50     | 0.255      | 0.0168        | 0.38  | .00163    | 5,100 | 8.30      |
| .00116 | 5.50     | .255       | .0474         | .50   | .00605    | 5,100 | 30.8      |
| .00232 | 6.80     | .147       | .1341         | .05   | .000988   | 5,100 | 5.04      |
| .00464 | 13.6     | .0122      | .3794         | .01   | .000046   | 5,100 | .23       |
| .00928 | 27.2     | —          | 1.073         | .01   | —         | 5,100 | —         |
| .01856 |          |            | 3.035         |       |           |       |           |

Notes:  $d_s$ —Depth at sampled verticals;  $d_n$ —Depth

not sampled;  $\frac{1}{}$  From normal section size analysis;  $\frac{2}{}$  From normal section average size curves;  $\frac{3}{}$  From contracted section analysis curves;  $\frac{4}{}$  The larger of  $\frac{1.65 D_{35}}{(SR)_m}$  or  $\frac{0.4 \times 1.65 D}{(SR)_m}$ ;  $\frac{5}{}$  Load in sampled zone from  $\frac{1}{}$ ;  $\frac{6}{}$  Load in sampled zone from  $\frac{2}{}$

| Measured suspended sediment | Size | .000036 | .00029 | .00058 | .00116 | .00232 | .00464 | .00928 | .01856 | .03712 |
|-----------------------------|------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| $\frac{1}{}$ %              |      | 28      | 24     | 39     | 9      |        |        |        |        |        |
| $\frac{2}{}$ %              |      | 22      | 25     | 42     | 11     |        |        |        |        |        |
| $\frac{3}{}$ %              |      | 11      | 14     | 45     | 27     | 3      |        |        |        |        |

Total sediment discharge

| Method                           | Determination of reference $z_2$   | D       | $\frac{5}{} Q'_s$ | $\frac{6}{} Q'_s$ | $i_B Q_B$ | Mult. | $z$   | $A''$   | $J_1'$ | $-J_2'$ | $J_1''$ | $-J_2''$ | $\frac{PJ_1'' + J_2''}{PJ_1' + J_2'}$ | $I_1''$ | $-I_2''$ | $P_1'' + I_2''$ | COMPUTED FROM $\frac{5}{}$ / FROM $\frac{6}{}$ | Meas. | % Diff. |     |
|----------------------------------|--|---------|-------------------|-------------------|-----------|-------|-------|---------|--------|---------|---------|----------|---------------------------------------|---------|----------|-----------------|--|-------|---------|-----|
| Trial and error solution for $z$ | Reference size is 0.00058  | .000036 | 36                | 29                |           | 0.021 | 0.016 | .000074 | 0.75   | 0.40    | 1.00    | 1.03     | $\frac{9.67}{7.63}$                   |         |          |                 | 46   | 52    | -12     |     |
|                                  | $\frac{Q'_s}{i_B Q_B} = \frac{I_1''}{J_1''} (PJ_1' + J_2')$ ; solve for $z_2$ .                          | .00029  | 31                | 32                |           | .44   | .34   | .00059  | .64    | .43     | 1.22    | 2.04     | $\frac{11.03}{6.42}$                  |         |          |                 | 53   | 66    | -20     |     |
|                                  | $\frac{Q'_s}{i_B Q_B} = \left(\frac{51}{8.30}\right) = 6.14$ ; Try $z_2 = 0.82$                          | .00058  | 51                | 55                | 8.30      | 1.00  | .77   | .00118  |        |         |         |          |                                       |         | 2.78     | 8.40            | 22.4   | 186   | 211     | -12 |
|                                  | $6.14 = \frac{2.29}{3.15} [10.7(0.62) - 0.53] = 4.44$  | .00116  | 12                | 14                | 30.8      | 1.76  | 1.35  | .00237  |        |         |         |          |                                       |         | .48      | 2.13            | 4.01   | 124   | 127     | -2  |
|                                  | Try $z_2 = 0.77$   | .00232  |                   |                   | 5.04      | 2.59  | 1.99  | .00474  |        |         |         |          |                                       |         | .204     | .95             | 2.23   | 11    | 14      | -21 |
|                                  | $6.14 = \frac{2.29}{3.15} [10.7(0.62) - 0.53] = 4.44$  | .00464  |                   |                   | .23       | 3.45  | 2.66  | .00947  |        |         |         |          |                                       |         | .123     | .53             | 1.78   | —     | —       |     |
|                                  | Try $z_2 = 0.77$   | .00928  |                   |                   |           |       |       |         |        |         |         |          |                                       |         |          |                 |  | 420   | 470     | -11 |
|                                  | $6.14 = \frac{2.78}{2.72} [10.7(0.62) - 0.50] = 6.27$  | .01856  |                   |                   |           |       |       |         |        |         |         |          |                                       |         |          |                 |  |       |         |     |
| $z$ from equation                | Determination of reference $z_4$ and comparable $i_B Q_B$  | .000036 | 36                |                   |           | 0.021 | .015  | .000074 | 0.75   | 0.40    | 1.00    | 1.03     | $\frac{9.67}{7.63}$                   |         |          |                 | 46   | 52    | -12     |     |
|                                  | Reference size is 0.00058  | .00029  | 31                |                   |           | .44   | .30   | .00059  | .65    | .43     | 1.15    | 1.83     | $\frac{10.47}{6.53}$                  |         |          |                 | 50   | 66    | -24     |     |
|                                  | $z_4 = 4.6 (V_s)^{0.7} = 4.6 (0.067)^{0.7} = 0.69$   | .00058  | 51                |                   | 4.69      | 1.00  | .69   | .00118  |        |         |         |          |                                       |         | 3.90     | 10.9            | 31.8   | 149   | 211     | -30 |
|                                  | $i_B Q_B = \frac{J_1'' Q'_s}{I_1'' (PJ_1' + J_2')} = \frac{(2.21)(51)}{3.90 [10.7(0.62) - 0.47]} = 4.69$ | .00116  | 12                |                   | 17.4      | 1.76  | 1.21  | .00237  |        |         |         |          |                                       |         | .64      | 2.62            | 5.23   | 91    | 127     | -28 |
|                                  |  | .00232  |                   |                   | 2.84      | 2.59  | 1.79  | .00474  |        |         |         |          |                                       |         | .252     | 1.11            | 2.59   | 7     | 14      | -50 |
|                                  |  | .00464  |                   |                   | .13       | 3.45  | 2.38  | .00947  |        |         |         |          |                                       |         | .147     | .61             | 1.95   | —     | —       |     |
|                                  |  | .00928  |                   |                   |           |       |       |         |        |         |         |          |                                       |         |          |                 |  | 343   | 470     | -27 |
|                                  |  | .01856  |                   |                   |           |       |       |         |        |         |         |          |                                       |         |          |                 |  |       |         |     |
|                                  | .03712   |         |                   |                   |           |       |       |         |        |         |         |          |                                       |         |          |                 |  |       |         |     |

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COMPUTATION OF TOTAL SEDIMENT DISCHARGE