COMPUTING APPROXIMATE SEDIMENT BULKING FACTORS FOR HYDROLOGIC USE IN NORTH ALBUQUERQUE ACRES CITY OF ALBUQUERQUE, NEW MEXICO

1. INTRODUCTION

Resource Technology, Inc. (RTI) was contracted by Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) to prepare "Drainage Management Plan (DMP) for La Cueva, El Camino and North Camino Arroyos." These arroyos are located in North Albuquerque Acres, City of Albuquerque, New Mexico. As part of DMP, RTI computed sediment bulking factors at several locations (from Tramway Blvd. to I-25) using AHYMO194 model. The AHYMO194 is state of the art hydrology model for the City of Albuquerque. In this paper, an attempt is made to correlate the peak clear water discharge with sediment bulking factors in an equation form for limited use in adjusting peak flow rates to account for sediment load where a higher degree of accuracy does not justify the expense of more detailed analysis.

2. DEVELOPMENT OF HYDROLOGY MODEL

Hydrology was computed using the AHYMO194 model. The hydrology model extends from Sandia Mountains to past I-25 for all three arroyos. The initial abstraction and uniform loss rates were chosen as defined in Section 22.2, Hydrology of the Development Process Manual (DPM), Volume 2, Design Criteria for the City of Albuquerque, New Mexico. The land treatments used in the model were chosen based on man-made development and slope criteria given in the DPM. Rock outcrop areas of the Sandia Mountains were initially regarded as totally impervious areas, land treatment type "D." Finally the steep slope procedure was applied, as specified in the DPM, to sub-basins with greater than 4% slopes.

After the regression analysis in this paper, the hydrology model was modified to the extent that rock outcrops were considered the same as compacted natural soil, land treatment type "C," rather than as totally impervious. However this should not affect the regression analysis performed for this paper because the analysis relates the absolute peak discharge (in cfs) to the sediment bulking factor (in percent) in the study area.

3. SOIL SAMPLES

The soil samples were collected in plastic bags at twenty-three locations. These locations range from Tramway Blvd. to I-25. The samples were collected in all three arroyos. Some samples were collected in the arroyos and some were collected in the watershed area. The top two inches of soil cover was removed before collecting any samples. However, only those samples that were collected in the arroyos were used in the sediment analysis.

After collecting these soil samples, they were taken to the soil testing laboratory for sieve analysis to obtain the soil gradation information. Using this information, the D_{50} (median size) was determined for all the samples. These median sizes ranged from 1.5 to 3 mm. See Appendix B.

4. SEDIMENT TRANSPORT ANALYSIS

The sediment transport analysis is described in the "Sediment and Erosion Design Guide" for the Albuquerque area. This guide was compiled by Resource Consultants & Engineers, Inc. for AMAFCA. The sediment transport analysis involves using the hydrology model, to determine sediment wash loads and flow rates for various frequencies, hydraulic model to determine hydraulic characteristics at various flow rates, and then the hydrology model again with the wash load data and hydraulic rating curves to determine sediment transport capacity and bulking factors. The hydraulics model used was the U.S. Army Corps of Engineers' HEC-2. The AHYMO194 model was used to compute the sediment yield (wash load) as well as sediment bed-load using the commands SEDIMENT WASH LOAD and SEDIMENT TRANS respectively. The SEDIMENT WASH LOAD uses the MUSLE equation to compute the sediment yield. The SEDIMENT TRANS can use either MPM-WOO bed-load equation or Zeller and Fullerton relation. For this project, MPM-WOO equation was selected.

The sediment transport analysis procedure consists of following steps:

A. Develop the hydrology model using AHYMO194.
B. Using the best available topographic data, generate cross-sections and identify reaches based on similar cross-section characteristics. Develop hydraulic models (i.e., HEC-2 models) for each arroyo.
C. Run hydraulic model with a range of discharges. Obtain the velocity and top width for each discharge for each cross-section.
D. Average the velocity and top width parameters for a given discharge and the reach.
E. Compile the sediment wash load parameters. This information was compiled from four sources. They are: 1) Sediment and Erosion Design Guide (Resource Consultants & Engineers, 1994); 2) Prudent analysis, La Cueva Arroyo and Watershed Between Tennyson Street and Modesto Avenue (Resource Consultants & Engineers, 1992); 3) Albuquerque Arroyos Sedimentation Study Numerical Model Investigation (U.S. Army Corps of Engineers, 1995); and, 4) Soil Survey Maps.
F. Compile the sediment bed-load parameters using D_{50} from soil gradation samples and "Sediment and Erosion Design Guide."
G. Input the sediment wash load parameters, sediment bed-load parameters and average values of velocity and top width for a given peak discharge and reach into the AHYMO194 model below the hydrograph of interest.
H. Run AHYMO194 model to get the sediment bulking factors. There are two sediment bulking factors. One is for the peak discharge value (peak sediment bulking factor) and the other is for the entire hydrograph (average sediment bulking factor).

5. SELECTION OF SAMPLE DATA

The sediment bulking factors were computed for 2-, 5-, 10-, 25-, 50- and 100-year return periods in the DMP for all three arroyos. However, the data for 100-year and 10-year return periods were chosen as the sample data because of the large number of data points. The reason behind selecting the two return periods instead of one was to obtain the range of sediment bulking factors for the regression analysis. The average sediment bulking factors were used as the sample data.

6. REGRESSION ANALYSIS

6.1 CURVE Program

The CURVE program, written by U.S. Army Corps of Engineers for DOS applications, was used in performing this regression analysis. This program contains the algorithm for nine different equations. They are of following form:

Exponential:	$SB = A * e^{B * Q}$	(1)
Power:	$SB = A * Q^{B}$	(2)
Common LOG (LOG1):	$SB = A_1 + A_2 * LOG(Q) + A_3 * (LOG(Q))^2$	(3)
Common LOG (LOG2):	$SB = A_1 + A_2 * Q + A_3 * LOG(Q)$	(4)
Natural LOG (LOG1):	$SB = A + B * LN(Q)$	(5)
Polynomial (Degree 1):	$SB = A_1 + A_2 * Q$	(6)
Polynomial (Degree 2):	$SB = A_1 + A_2 * Q + A_3 * Q^2$	(7)
Polynomial (Degree 3):	$SB = A_1 + A_2 * Q + A_3 * Q^2 + A_4 * Q^3$	(8)
Hyperbola:	$SB = A + (B/Q)$	(9)

where

SB = Sediment bulking factor in percent
Q = Peak discharge in cfs
A, B, A_1, A_2, A_3, A_4 = Regression constants

RTI used one additional equation which is not part of the CURVE program:

$$SB = 10^{((Q + A)/B)} \qquad (10)$$

The regression analysis for this equation was performed separately in the spreadsheet program Quattro Pro (Version 6.0 for Windows).

6.2 Slope Criteria

The data were divided into two different slope data sets, one with flatter slopes (< 3.5%) and the other with steeper slopes (≥ 3.5%). It was initially thought that slope as well as flow rate might be a significant variables. Regression analysis was performed on these two different data sets to obtain two different equations using the CURVE program as well as the Quattro Pro (Version 6.0 for Windows) spreadsheet.

6.3 Results

The sample correlation coefficient (r^2) in regression analysis gives a measure of the curves fit with the observed data. The closer this parameter is to 1, the better the degree of curve fit. The correlation coefficients along with the equations are given in Table 1 and Table 2.

Table 1. Regression Results for Flatter Slopes (< 3.5%) N = 60

Equation #	Correlation Coefficient	Equation
1	0.30	$SB = 4.34 * e^{0.00018 * Q}$
2	0.20	$SB = 1.06 * Q^{0.24}$
3	0.35	$SB = 61.27 - 40.23 * LOG(Q) + 7.17 * (LOG(Q))^2$
4	0.36	$SB = 11.99 + 0.002 * (Q) - 2.97 * LOG(Q)$
5	0.26	$SB = -5.70 + 1.67 * LN(Q)$
6	0.34	$SB = 4.13 + 0.0013 * Q$
7	0.37	$SB = 4.95 + 0.00006 * Q$
8	0.37	$SB = 5.07 - 0.00023 * Q$
9	0.16	$SB = 7.40 - 1236.58/Q$
10	0.37	$SB = 10^{(Q + 2139.95)/4751.74)}$

Table 2. Regression Results for Steeper Slopes (≥ 3.5%) N = 23

Equation #	Correlation Coefficient	Equation
1	0.64	$SB = 3.45 * e^{0.00038 * Q}$
2	0.57	$SB = 0.07 * Q^{0.63}$
3	0.62	$SB = 84.73 - 60.66 * LOGg(Q) + 11.40 * (LOG(Q))^2$
4	0.62	$SB = 2.37 + 0.003 * (Q) - 0.066 * LOG(Q)$
5	0.57	$SB = -25.8 + 4.62 * LN(Q)$
6	0.62	$SB = 2.55 + 0.00295 * Q$
7	0.62	$SB = 2.64 + 0.00284 * Q$
8	0.63	$SB = 0.09 + 0.0089 * Q$
9	0.41	$SB = 11.64 - 4284.92/Q$
10	0.59	$SB = 10^{(Q + 1206.6)/3612.59)}$

Table 3 and Table 4 list the original sediment bulking factor data used in the regression analysis along with that computed using the regression coefficients for each equation.

For slopes less than 3.5%, Equations 1, 2, 5 and 9 do not represent a good correlation between the peak discharge and sediment bulking factor based on the correlation coefficient. Equations 7 and 8 can also be eliminated because these equations are showing a linear correlation while they themselves are non-linear. In Equations. 3 and 4, the predicted sediment bulking factor decreases with increase in peak discharge for a particular range as evident from Table 3. The Equation 10 has a slightly better correlation coefficient than that for Equation 6. However, to keep the equation simple, the linear equation (Equation 6) was selected as the sediment bulking factor equation for flatter slopes (i.e., slopes lower than 3.5%).

Table 3. Results of Regression Analysis for Flatter Slopes (< 3.5%)

Peak Discharge (cfs)	Original Average Sediment Bulking Factors	Calculated Average Sediment Bulking Factors									
		Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6	Equation 7	Equation 8	Equation 9	Equation 10
350	4.4	4.7	4.3	5.4	5.2	4.1	4.6	5.0	5.0	3.9	3.3
350	5.6	4.7	4.3	5.4	5.2	4.1	4.6	5.0	5.0	3.9	3.3
386	5.4	4.7	4.4	5.2	5.1	4.2	4.6	5.0	5.0	4.2	3.4
386	4.2	4.7	4.4	5.2	5.1	4.2	4.6	5.0	5.0	4.2	3.4
386	5.2	4.7	4.4	5.2	5.1	4.2	4.6	5.0	5.0	4.2	3.4
399	5.0	4.7	4.4	5.2	5.1	4.3	4.6	5.0	5.0	4.3	3.4
399	4.4	4.7	4.4	5.2	5.1	4.3	4.6	5.0	5.0	4.3	3.4
399	4.1	4.7	4.4	5.2	5.1	4.3	4.6	5.0	5.0	4.3	3.4
511	3.9	4.8	4.7	4.9	5.0	4.7	4.8	5.0	5.0	5.0	3.6
511	4.0	4.8	4.7	4.9	5.0	4.7	4.8	5.0	5.0	5.0	3.6
511	3.4	4.8	4.7	4.9	5.0	4.7	4.8	5.0	5.0	5.0	3.6
524	5.7	4.8	4.7	4.9	5.0	4.7	4.8	5.0	4.9	5.0	3.6
524	3.8	4.8	4.7	4.9	5.0	4.7	4.8	5.0	4.9	5.0	3.6
524	8.5	4.8	4.7	4.9	5.0	4.7	4.8	5.0	4.9	5.0	3.6
661	5.2	4.9	5.0	4.9	5.0	5.1	5.0	5.0	4.9	5.5	3.9
661	8.2	4.9	5.0	4.9	5.0	5.1	5.0	5.0	4.9	5.5	3.9
729	7.3	5.0	5.1	4.9	5.0	5.3	5.1	5.0	4.9	5.7	4.0
729	6.8	5.0	5.1	4.9	5.0	5.3	5.1	5.0	4.9	5.7	4.0
729	5.0	5.0	5.1	4.9	5.0	5.3	5.1	5.0	4.9	5.7	4.0
752	5.5	5.0	5.2	4.9	5.0	5.3	5.1	5.0	4.9	5.8	4.1
752	5.2	5.0	5.2	4.9	5.0	5.3	5.1	5.0	4.9	5.8	4.1
752	5.7	5.0	5.2	4.9	5.0	5.3	5.1	5.0	4.9	5.8	4.1
964	3.6	5.2	5.5	5.1	5.2	5.8	5.4	5.0	4.8	6.1	4.5
964	4.2	5.2	5.5	5.1	5.2	5.8	5.4	5.0	4.8	6.1	4.5
964	4.7	5.2	5.5	5.1	5.2	5.8	5.4	5.0	4.8	6.1	4.5
988	4.2	5.2	5.5	5.1	5.2	5.8	5.4	5.0	4.8	6.2	4.6
988	8.6	5.2	5.5	5.1	5.2	5.8	5.4	5.0	4.8	6.2	4.6
988	7.4	5.2	5.5	5.1	5.2	5.8	5.4	5.0	4.8	6.2	4.6
1039	5.5	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7
1039	4.6	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7

Table 3. **Results of Regression Analysis for Flatter Slopes (< 3.5%)**

Peak Discharge (cfs)	Original Average Sediment Bulking Factors	Calculated Average Sediment Bulking Factors									
		Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6	Equation 7	Equation 8	Equation 9	Equation 10
1047	5.6	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7
1047	4.2	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7
1050	4.0	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7
1050	4.1	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7
1050	3.9	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7
1050	4.9	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7
1050	4.9	5.3	5.6	5.2	5.2	5.9	5.5	5.0	4.8	6.2	4.7
1961	6.9	6.2	6.5	6.6	6.4	6.9	6.7	5.1	4.6	6.8	7.3
1961	5.7	6.2	6.5	6.6	6.4	6.9	6.7	5.1	4.6	6.8	7.3
1976	4.8	6.2	6.5	6.6	6.4	6.9	6.7	5.1	4.6	6.8	7.3
1976	7.4	6.2	6.5	6.6	6.4	6.9	6.7	5.1	4.6	6.8	7.3
1981	5.3	6.3	6.5	6.6	6.4	7.0	6.7	5.1	4.6	6.8	7.4
1981	4.9	6.3	6.5	6.6	6.4	7.0	6.7	5.1	4.6	6.8	7.4
1981	5.4	6.3	6.5	6.6	6.4	7.0	6.7	5.1	4.6	6.8	7.4
1981	4.6	6.3	6.5	6.6	6.4	7.0	6.7	5.1	4.6	6.8	7.4
1981	5.5	6.3	6.5	6.6	6.4	7.0	6.7	5.1	4.6	6.8	7.4
2008	5.8	6.3	6.5	6.7	6.4	7.0	6.7	5.1	4.6	6.8	7.5
2008	5.1	6.3	6.5	6.7	6.4	7.0	6.7	5.1	4.6	6.8	7.5
2057	6.2	6.3	6.6	6.7	6.5	7.0	6.8	5.1	4.6	6.8	7.6
2057	11.7	6.3	6.6	6.7	6.5	7.0	6.8	5.1	4.6	6.8	7.6
2057	7.0	6.3	6.6	6.7	6.5	7.0	6.8	5.1	4.6	6.8	7.6
2099	8.5	6.4	6.6	6.8	6.6	7.0	6.9	5.1	4.6	6.8	7.8
2099	6.9	6.4	6.6	6.8	6.6	7.0	6.9	5.1	4.6	6.8	7.8
3788	8.1	8.7	7.6	9.2	9.4	8.0	9.1	5.2	4.2	7.1	17.7
3788	6.6	8.7	7.6	9.2	9.4	8.0	9.1	5.2	4.2	7.1	17.7
3882	8.1	8.8	7.6	9.3	9.6	8.1	9.2	5.2	4.2	7.1	18.5
3882	7.8	8.8	7.6	9.3	9.6	8.1	9.2	5.2	4.2	7.1	18.5
3882	18.4	8.8	7.6	9.3	9.6	8.1	9.2	5.2	4.2	7.1	18.5
3961	7.8	8.9	7.7	9.4	9.7	8.1	9.3	5.2	4.2	7.1	19.2
3961	10.4	8.9	7.7	9.4	9.7	8.1	9.3	5.2	4.2	7.1	19.2

Table 4. Results of Regression Analysis for Steeper Slopes (> 3.5%)

Peak Discharge (cfs)	Original Average Sediment Bulking Factors	Calculated Average Sediment Bulking Factors									
		Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6	Equation 7	Equation 8	Equation 9	Equation 10
399	5.5	4.0	3.0	4.0	3.4	1.9	3.7	3.8	3.6	0.9	2.8
485	3.4	4.1	3.4	4.0	3.6	2.8	4.0	4.0	4.4	2.8	2.9
498	3.2	4.2	3.5	4.0	3.7	2.9	4.0	4.1	4.5	3.0	3.0
540	1.9	4.2	3.7	4.1	3.8	3.3	4.1	4.2	4.9	3.7	3.0
752	6.2	4.6	4.5	4.5	4.4	4.8	4.8	4.8	6.8	5.9	3.5
988	8.6	5.0	5.4	5.3	5.1	6.1	5.5	5.4	8.9	7.3	4.1
1039	5.9	5.1	5.5	5.4	5.2	6.3	5.6	5.6	9.4	7.5	4.2
1045	4.2	5.1	5.5	5.5	5.2	6.4	5.6	5.6	9.4	7.5	4.2
1046	3.9	5.1	5.5	5.5	5.2	6.4	5.6	5.6	9.4	7.5	4.2
1050	8.0	5.1	5.6	5.5	5.3	6.4	5.6	5.6	9.5	7.6	4.2
1213	2.8	5.4	6.1	6.0	5.7	7.1	6.1	6.1	10.9	8.1	4.7
1900	9.7	7.0	8.1	8.3	7.7	9.1	8.2	8.0	17.0	9.4	7.2
1900	7.1	7.0	8.1	8.3	7.7	9.1	8.2	8.0	17.0	9.4	7.2
1900	12.3	7.0	8.1	8.3	7.7	9.1	8.2	8.0	17.0	9.4	7.2
1961	7.6	7.2	8.2	8.5	7.9	9.3	8.3	8.2	17.6	9.5	7.5
1981	9.4	7.3	8.3	8.6	8.0	9.3	8.4	8.3	17.8	9.5	7.6
1997	6.6	7.3	8.3	8.7	8.0	9.4	8.4	8.3	17.9	9.5	7.7
1997	7.2	7.3	8.3	8.7	8.0	9.4	8.4	8.3	17.9	9.5	7.7
3584	15.0	13.3	12.0	13.1	12.6	12.1	13.1	12.8	32.1	10.4	21.2
3584	10.8	13.3	12.0	13.1	12.6	12.1	13.1	12.8	32.1	10.4	21.2
3767	10.8	14.2	12.4	13.5	13.2	12.3	13.7	13.3	33.7	10.5	23.8
3767	9.2	14.2	12.4	13.5	13.2	12.3	13.7	13.3	33.7	10.5	23.8
3884	21.1	14.9	12.6	13.8	13.5	12.4	14.0	13.7	34.7	10.5	25.7

For steeper slopes, Equations 7, 8 and 9 were eliminated for the same reasons as those identified for flatter slopes. Equations 3 and 4 were eliminated considering the behavior of these equations under flatter slopes criteria. Equations 2, 5 and 10 were eliminated considering the low correlation coefficients. Equations 1 and 6 gave reasonable results and have nearly identical correlation coefficients. For the purpose of simplicity and consistency with the equation for flatter slopes, the linear equation (Equation. 6) was selected as the sediment bulking factor equation for the slopes greater than or equal to 3.5%.

The two selected equations were:

$$SB = 4.13 + (0.0013 \text{ X } Q) \text{ for flatter slopes } (< 3.5\%)$$
$$SB = 2.55 + (0.00295 \text{ X } Q) \text{ for steeper slopes } (\geq 3.5\%)$$

However, the predicted sediment bulking factors for flatter slopes are greater than those for steeper slopes at low discharges. This did not seem to be reasonable.

For this reason, it was decided to combine all the data points into one data set and ignore the effects of slope. Also, instead of performing the regression analysis on all ten equations, it was decided to perform only linear regression analysis. The correlation coefficient for this new equation was 0.43. This equation is:

$$SB = 3.622 + (0.001875 \times Q)$$

where SB = Average sediment bulking factor (in percent)
Q = Discharge (in cfs)

Figure 1 shows the above equation (solid line) with original data points. Table 5 documents the original sediment bulking factors along with the computed sediment bulking factor using the above equation. For the purpose of simplicity, Table 6 is created to show the predicted sediment bulking factors (rounded off to nearest integer) for the corresponding range of peak discharge values.

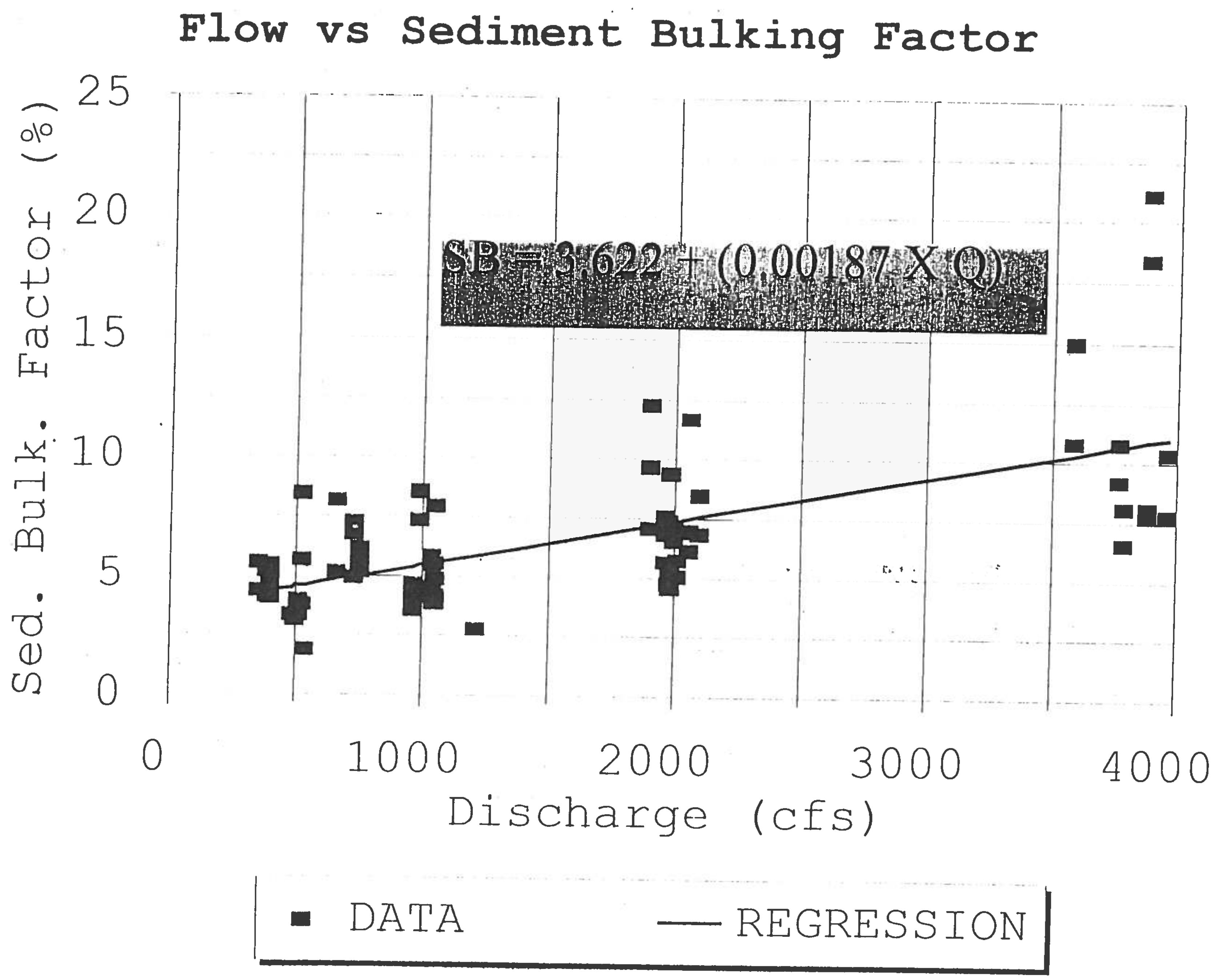

Figure 1. Discharge vs. Average Sediment Bulking Factors From Final Regression Equation

Peak Discharge (cfs)	Original Average Sediment Bulking Factors	Calculated Average Sediment Bulking Factors*
350	5.6	4.3
350	4.4	4.3
386	5.2	4.3
386	4.2	4.3
386	5.4	4.3
399	4.1	4.4
399	5.5	4.4
399	5.0	4.4
399	4.4	4.4
485	3.4	4.5
498	3.2	4.6
511	3.9	4.6
511	4.0	4.6
511	3.4	4.6
524	5.7	4.6
524	3.8	4.6
524	8.5	4.6
540	1.9	4.6
661	5.2	4.9
661	8.2	4.9
729	5.0	5.0
729	7.3	5.0
729	6.8	5.0
752	6.2	5.0
752	5.2	5.0
752	5.7	5.0
752	5.5	5.0
964	3.6	5.4
964	4.2	5.4
964	4.7	5.4
988	8.6	5.5
988	4.2	5.5
988	8.6	5.5
988	7.4	5.5
1039	5.9	5.6
1039	5.5	5.6
1039	4.6	5.6
1045	4.2	5.6
1046	3.9	5.6
1047	4.2	5.6
1047	5.6	5.6
1050	3.9	5.6

Table 5. Results of Final Prediction Equation for Sediment Bulking Factors

Table 5. Results of Final Prediction Equation for Sediment Bulking Factors		
Peak Discharge (cfs)	Original Average Sediment Bulking Factors	Calculated Average Sediment Bulking Factors*
1050	8.0	5.6
1050	4.9	5.6
1050	4.9	5.6
1050	4.1	5.6
1050	4.0	5.6
1213	2.8	5.9
1900	12.3	7.2
1900	7.1	7.2
1900	9.7	7.2
1961	5.7	7.3
1961	6.9	7.3
1961	7.6	7.3
1976	4.8	7.3
1976	7.4	7.3
1981	9.4	7.3
1981	5.4	7.3
1981	4.6	7.3
1981	5.5	7.3
1981	4.9	7.3
1981	5.3	7.3
1997	7.2	7.4
1997	6.6	7.4
2008	5.1	7.4
2008	5.8	7.4
2057	6.2	7.5
2057	11.7	7.5
2057	7.0	7.5
2099	6.9	7.6
2099	8.5	7.6
3584	10.8	10.3
3584	15.0	10.3
3767	10.8	10.7
3767	9.2	10.7
3788	8.1	10.7
3788	6.6	10.7
3882	18.4	10.9
3882	7.8	10.9
3882	8.1	10.9
3884	21.1	10.9
3961	7.8	11
3961	10.4	11

* Calculated using SB = 3.622 + (0.001875 X Q)

Table 6. Predicted Average Sediment Bulking Factors For a Given Discharge in North Albuquerque Acres Area, East of I-25

Unbulked Peak Discharge (cfs)	Average Sediment Bulking Factor* (%)
0 - 500	4
501 - 1000	5
1001 - 1600	6
1601 - 2100	7
2101 - 2600	8
2601 - 3200	9
3201 - 3700	10
3701 - 4200	11

*Rounded off to nearest integer.

7. CONCLUSION

The average sediment bulking factors were calculated for La Cueva, El Camino and North Camino arroyos using the methods presented in AMAFCA's "Sediment and Erosion Design Guide." A regression analysis was performed on these sediment bulking factors to obtain a correlation between the sediment bulking factors and peak discharge values irrespective of the slopes in corresponding watersheds. This analysis resulted in a linear equation

This prediction equation can be used to estimate the sediment bulking factor to be applied to clean water discharge rates in other natural arroyos with a similar geomorphology, soil characteristics and slopes in far northeast Albuquerque where approximate methods can be utilized. It should not be used where a higher degree of accuracy is required for sediment and erosion studies, such as for aggradation/degradation determination, prudent line analysis, scour at major hydraulic structures, etc. The relatively low correlation coefficient ($r^2 = .43$) indicates that there are clearly other factors which need to be considered besides clear water flow rates where the highest degree of accuracy is desired.