Appendix I
Notation

The following symbols are based on those used by the original authors:

A	parameter in Ackers and White's transport function; cross-sectional area; or soil loss in (ton/acre)/year in the universal soil loss equation
A_1, A_2, B_1, B_2	constants
A_c	a function used in Toffaleti's method
A_g	a volume of material to be degraded per unit channel width
A_h	reservoir area at a given elevation h
$A_L d$	average step length
A_m	amplitude of sand waves
A_o, A_{ijk}, B_o, B_{pqr}	constants used in Karim and Kennedy's equation
a	distance from the bed where bed-load is transported; rill width–depth ratio; or relative sediment area
a and a_s	thicknesses of bed layer and suspended layer, respectively
a'	distance from the bed to the sediment sampler inlet
B	roughness function or channel bottom width
b_f	bed form shape factor
C	Chezy's roughness coefficient or sediment concentration; parameter in Ackers and White's transport function; or cropping management factor in the universal soil loss equation
C and C_i	total sediment concentration and concentration for size i, respectively
C_b, C_s, and C_t	sediment concentrations (in ppm by weight) for bed-load, suspended load, and total bed-material load, respectively
C_D and C_L	drag and lift coefficients, respectively
C_f	friction coefficient; or fine sediment concentration

C_t	total sediment concentration, with wash load excluded (in ppm by weight)
C_{tg}	Total gravel concentration (in ppm by weight)
C_{ts}	total sand concentration (in ppm by weight)
C_{ui}, C_{mi}, and C_{Li}	sediment concentrations for size fraction i in the upper, middle, and lower zones defined by Toffaleti, respectively
C_v	sediment concentration by volume
C_{vy}	time-averaged sediment concentration by volume at a distance y above the bed
C'_s	measured sediment concentration in the sampled zone
$\overline{C}$ and $\overline{C_a}$	time-averaged sediment concentrations at a given cross-section and at a distance a above the bed, respectively
D	average flow depth or pipe diameter
D_c	critical depth required at incipient motion
D_g	depth of degradation
D_s and D_m	depths of sampled and unsampled zones, respectively
D_{gr}	dimensionless particle size
D_v	mean depth at a vertical where suspended sediment samples were taken
D' and D''	hydraulic depths for grain roughness and form roughness, respectively
d	sediment particle diameter
d_{35}, d_{50}, d_{65}, and d_{90}	sediment diameters where 35, 50, 65, and 90 percent of the materials are finer, respectively
d_{gr}	dimensionless grain diameter
E and E'	parameters used in the Einstein and modified Einstein procedures, respectively
e	dimensionless coefficient
e_b and e_s	transport efficiency coefficients for bed-load and suspended load, respectively
F	dimensionless function of total reservoir sediment deposition, capacity, depth, and area

F_D, F_L, and F_R	drag, lift, and resisting forces acting on a sediment particle, respectively
F_{gr}	Ackers and White's mobility number
F_r	Froude number
f	Darcy–Weisbach friction coefficient
f and f_o	resistance coefficients of sediment-laden flow and clear water, respectively
f' and f''	Darcy–Weisbach friction coefficients for grain and form roughness, respectively
f'	Engelund and Hansen's transport function
G_{gr}	Ackers and White's sediment transport function
g	gravitational acceleration
H	original depth of reservoir
h_f	friction loss
I, J	dimensionless parameters
I_1, I_2	parameters in Einstein's and Chang's transport functions
i_{BW}	percentage of bed-load by weight of size d
i_{bw}	number of particles available on the bed
J	number of rills
J_1, J_2	parameters used in the modified Einstein procedure
K	soil erodibility factor in the universal soil loss equation
K, K', K'', K_1, K_2, K_3	parameters or constants
K_r, K_s	coefficients in the Meyer-Peter and Müller formula
K_t	Chang, Simons, and Richardson's bed-load discharge coefficient
k	von Kármán–Prandtl universal constant (= 0.4); or other constant
k_s	equivalent sediment diameter for roughness computation; average height; or roughness element
k_1, k_2, k_3	correction factors in Colby's approach; or parameters

L	slope-length factor in the universal soil loss equation; or length
$M, N, M_1, N_1, M_2, N_2, M_3, N_3$	dimensionless parameters
M_O and M_R	overturning and resisting moments, respectively
m	exponent in the universal soil loss equation; or parameter in Ackers and White's transport function
N_d and N_e	rates of number of sediment particles deposited and eroded, respectively
n	Manning's roughness coefficient; or transition exponent in Ackers and White's mobility number
P	erosion-control particle factor in the universal soil loss equation; total power available per unit channel width; or wetted perimeter
P_B	parameter used in the Einstein procedure
P_E	parameters used in the Einstein's transport function
$\overline{P}_i$ and p	time-averaged and fluctuating part of pressure, respectively
P_1, P_s, P_b, and P_2	power expenditure per unit channel width to overcome resistance, transport suspended load, bed-load, and other causes, respectively
p	relative depth of reservoir measured from the bottom; porosity; or probability
p_c, p_m, and p_s	percentages of clay, silt, and sand, of the incoming sediment to a reservoir, respectively
p_i	percentage of material available in size i
Q	water discharge
QS	stream power
Q_s	suspended load
Q_{ti}	total sediment discharge for size fraction i
Q'	water discharge in the sampled zone
q, q_b, and q_s	water discharge, bed-load, and sediment discharge per unit channel width, respectively
q_B	bed-load discharge per unit channel width

q_{Bi}, q_{sli}, q_{smi}, and q_{sLi}	sediment load per unit channel width in the bed-load, upper, middle, and lower zones defined by Toffaleti, respectively
q_{bv} and q_{bw}	bed-load by volume and by weight per unit channel width, respectively
q_c	critical discharge per unit channel width required at incipient motion
q'_s	sediment discharge per unit channel width in the sampled zone
q_{sv} and q_{sw}	suspended sediment load per unit channel width by volume and by weight, respectively
q_t	total bed-material load per unit channel width
q^2	$u_i u_i$
R	rainfall factor in the universal soil loss equation; or hydraulic radius
R_e	Reynolds number
R_s	parameter containing integrals I_1 and I_2
R' and R''	hydraulic radii due to grain roughness and form roughness, respectively
r	sediment particle radius
S	water surface or energy slope; or slope-steepness factor in the universal soil loss equation
S_d	total reservoir sediment deposition
S_O	energy slope of clear water
S_p	shape factor
S' and S''	friction slopes due to grain roughness and form roughness, respectively
T	time; or temperature
t	time
$\tan \alpha$	ratio of tangential to normal shear force
$\overline{U}_1$ and u_i	time-averaged and fluctuating part of the velocity in the *i* direction, respectively
U_*	shear velocity
u and v	local velocities in the x and y directions, respectively
u_b and u_s	velocities of bed-load and suspended load

u_x *and* u_y	fluctuating parts of the velocity in the *x* and *y* directions, respectively
$\overline{u}$	time-averaged local velocity
V *and* V_{cr}	average flow velocity and critical velocity at incipient motion, respectively
V_b	bottom velocity
VS *and* $V_{cr}S$	Yang's unit stream power and critical unit stream power required at incipient motion, respectively
V_y	time-averaged flow velocity at a distance *y* above the bed
W	unit weight of sediment deposit (in lb/ft3); channel top width; or rill shape factor
Wc, Wm, and Ws	initial weights of clay, silt, and sand, respectively, based on reservoir operation
W_O *and* W_T	initial and average reservoir sediment densities after *T* years of operation, respectively
W_s, W'	submerged weight of sediment
$W_i{}^*$	Parker's dimensionless bed-load
X	sediment concentration flux by weight in Ackers and White's transport function; or Einstein's characteristic grain size of sediment mixture
X_i, X_j, X_k, X_p, X_q, X_r	dimensionless variables used in Karim and Kennedy's equation
x	Einstein's correction factor, which is a function of *ks/δ*
Y	parameter used in Shen and Hung's equation; or Einstein's lifting correction factor
Y_a *and* Y_d	thickness of armoring layer and depth of degradation, respectively
y	potential energy per unit weight of water
Z	rill or channel side slope; or ω/kU_* (a parameter in Rouse's equation)
Z, Z_1	parameters used in the Einstein procedure

α	coefficient in Ackers and White's mobility number (=10); or longitudinal angle of inclination of a channel
β	angle of inclination of shear stress due to secondary motion; or coefficient
β_1	correction factor for non-uniform bed layer
γ, γ_m, γ_s, *and* γ_f	specific weights of water, sediment-laden flow, sediment, and fluid, respectively
γ_1, γ_2	discrepancy ratios
$\Delta = k_s/x$	Einstein's apparent roughness of bed surface
$\Delta = (\rho_s - \rho)/\rho$	relative density
δ	boundary layer thickness
ε_m *and* ε_s	momentum diffusion coefficients for fluid and sediment, respectively
ζ_s	specific gravity of sediment (= 2.65)
η	parameter for the fluctuation of velocity
η_1, η_2, η_3, η_v	exponents used in Toffaleti's method
θ	dimensionless shear stress used in Engelund and Hansen's transport function, and in Karim and Kennedy's equation; angle of slope in the universal soil loss equation; angle of inclination of channel bank; Engelund and Hansen's roughness function; or Shield's parameter
θ' *and* θ''	Engelund and Hansen's roughness functions for grain roughness and form roughness, respectively
θ_{cr} *and* θ_c	critical Shield's parameters for initiation of suspension and incipient motion, respectively
λ	slope length (in ft) in the universal soil loss equation; or porosity of bed material
μ	dynamic viscosity
μ, μ_m, *and* μ_r	dynamic viscosities of water, sediment-laden flow, and relative dynamic viscosity, respectively
ν *and* ν_m	kinematic viscosities of water and sediment-laden flow, respectively
ξ	relative depth = y/D; or Einstein's hiding correction factor

ρ, ρ_f, ρ_m, and ρ_s	densities of water, fluid, sediment-laden flow, and sediment, respectively
σ	standard deviation
τ and τ_c	shear stress and critical shear stress at incipient motion, respectively
τ_o	shear stress at the bed
τ_{xy}	turbulent shear stress
τ' and τ''	shear stresses due to grain roughness and form roughness, respectively
τ^*_{ri}	Parker's reference shear stress
τV	Bagnold's stream power
φ	Engelund and Hansen's transport functions; angle of repose; or velocity potential
φ_i	Parker's dimensionless shear stress for size d_i
φ_*	parameters used in Einstein's transport function
ψ, ψ', ψ_*	Einstein's transport functions
ω and ω_m	sediment fall velocities in clear water and sediment-laden flow, respectively

Appendix II
Conversion Factors

To convert	To	Multiply by
Length (L)		
inches (in.)	centimeters (cm)	2.54
feet (ft)	meters (m)	0.304 8
miles (miles)	kilometers (km)	1.609
meters (m)	inches (in.)	39.37
meters (m)	feet (ft)	3.281
kilometers (km)	miles (miles)	0.621 4
Area (L^2)		
square inches (in^2)	square centimeters (cm^2)	6.452
square feet (ft^2)	square meters (m^2)	0.092 90
square miles (sq miles)	square kilometers (km^2)	2.590
acres (acre)	square meters (m^2)	4047
square centimeters (cm^2)	square inches (in^2)	0.155 0
square meters (m^2)	square feet (ft^2)	10.76
hectares (ha)	acres (acre)	2.471
square kilometers (km^2)	square miles (sq miles)	0.3861
Volume (L^3)		
cubic inches (in^3)	cubic centimeters (cm^3)	16.39
cubic feet (ft^3)	cubic meters (m^3)	0.028 32
cubic yards (yd^3)	cubic meters (m^3)	0.764 6
gallons (gal)	liters (l)	3.785
cubic centimeters (cm^3)	cubic inches (in^3)	0.061 02
cubic meters (m^3)	cubic feet (ft^3)	35.31
liters (l)	cubic feet (ft^3)	0.035 31
liters (l)	gallons (gal)	0.264 2

To convert	To	Multiply by
Velocity (*L/T*)		
feet per second (ft/s)	meters per second (m/s)	0.304 8
meters per second (m/s)	feet per second (ft/s)	3.281
Discharge (L^3/T)		
cubic feet per second (ft3/s)	cubic meters per second (m^3/s)	0.028 32
cubic feet per second (ft3/s)	liters per second (l/s)	28.32
cubic meters per second (m^3/s)	cubic feet per second (ft^3/s)	35.31
liters per second (l/s)	cubic feet per second (ft^3/s)	0.035 31
Mass (*M*)		
pounds (lb)	kilograms (kg)	0.453 6
kilograms (kg)	pounds (lb)	2.205
Density (M/L^3)		
pounds per cubic foot (lb/ft^3)	kilograms per cubic meter (kg/m^3)	16.02
kilograms per cubic meter (kg/m^3)	pounds per cubic foot (lb/ft^3)	0.02 43
kilograms per cubic meter (kg/m^3)	grams per cubic centimeter (g/cm^3)	0.001 00
Force (ML/T^2) †		
pounds (lb)	kilograms (kg)	0.453 6
pounds (lb)	newtons (N)	4.448
kilograms (kg)	pounds (lb)	2.205
kilograms (kg)	newtons (N)	9.807
newtons (N) ‡	kilograms (kg)	0.102 0
newtons (N)	pounds (lb)	0.224 8
dynes (dyn)	newtons (N)	0.000 01

To convert	To	Multiply by
Pressure (M/LT^2) †		
pounds per square inch (lb/in^2)	kilograms per square meter (kg/m^2)	703.1
pounds per square inch (lb/in^2)	newtons per square meter (N/m^2)	6895
pounds per square foot (lb/ft^2)	kilograms per square meter (kg/m^2)	4.882
pounds per square foot (lb/ft^2)	newtons per square meter (N/m^2)	47.88
kilograms per square meter (kg/m^2)	pounds per square inch (lb/in^2)	0.001 422
kilograms per square meter (kg/m^2)	pounds per square foot (lb/ft^2)	0.204 8
kilograms per square meter (kg/m^2)	newtons per square meter (N/m^2)	9.807
Specific weights (M/L^2T^2) †		
pounds per cubic foot (lb/ft^3)	kilograms per cubic meter (kg/m^3)	16.02
pounds per cubic foot (lb/ft^3)	newtons per cubic meter (N/m^3)	157.1
kilograms per cubic meter (kg/m^3)	pounds per cubic foot (lb/ft^3)	0.062 43
kilograms per cubic meter (kg/m^3)	newtons per cubic meter (N/m^3)	9.807
Kinematic viscosity (L^2/T)		
square feet per second (ft^2/s)	square centimeters per second (cm^2/s)	929.0
square feet per second (ft^2/s)	square meters per second (m^2/s)	0.092 90
square meters per second (m^2/s)	square feet per second (ft^2/s)	10.76
square meters per second (m^2/s)	square centimeters per second (cm^2/s)	1000

† The factors relating pounds of force, kilograms of force, and newtons are based on the standard value of the gravitational acceleration, $g = 32.174\ ft/s^2 = 9.806\ 65\ m/s^2$.

‡ $1\ N = 1\ kg\text{-}m/s^2$.

Appendix III
Physical Properties of Water

IMPERIAL (ENGLISH) UNITS

Temperature (°F)	Specific weight γ (lb/ft³)	Density ρ (slugs/ft³)	Viscosity $\mu \times 10^5$ (lb-s/ft²)	Kinematic viscosity $\nu \times 10^5$ (ft²/s)
32	62.42	1.940	3.746	1.931
40	62.43	1.941	3.229	1.664
50	62.41	1.940	2.735	1.410
60	62.37	1.938	2.359	1.217
70	62.30	1.936	2.050	1.059
80	62.22	1.934	1.799	0.930
90	62.11	1.931	1.595	0.826
100	62.00	1.927	1.424	0.739
110	61.86	1.923	1.284	0.667
120	61.71	1.918	1.168	0.609
130	61.55	1.913	1.069	0.558
140	61.38	1.908	0.981	0.514
150	61.20	1.902	0.905	0.476
160	61.00	1.896	0.838	0.442
170	60.80	1.890	0.780	0.413
180	60.58	1.883	0.726	0.385
190	60.36	1.876	0.678	0.362
200	60.12	1.868	0.637	0.341
212	59.83	1.860	0.593	0.319

METRIC UNITS

Temperature (°C)	Specific weight γ (kN/m³)	Density ρ (kg/m³)	Viscosity $\mu \times 10^3$ (N-s/m²)	Kinematic viscosity $\nu \times 10^6$ (m²/s)
0	9.805	999.8	1.781	1.785
5	9.807	1000.0	1.518	1.519
10	9.804	999.7	1.307	1.306
15	9.798	999.1	1.139	1.139
20	9.789	998.2	1.002	1.003
25	9.777	997.0	0.890	0.893
30	9.764	995.7	0.789	0.800
40	9.730	992.2	0.653	0.658
50	9.689	988.0	0.547	0.553
60	9.642	983.2	0.466	0.474
70	9.589	977.8	0.404	0.413
80	9.530	971.8	0.354	0.364
90	9.466	965.3	0.315	0.326
100	9.399	958.4	0.282	0.294