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Glossary and Conversion Factors for Water Resources Engineers

Mu-Hao Sung Wang and Lawrence K. Wang

Contents

Abstract Technical and legal terms commonly used by water resources engineers are introduced in this chapter. With the current trend toward metrication, the question of using a consistent system of units has been a problem. Wherever possible, the authors of this Handbook of Environmental Engineering series have used the US customary system (fps) along with the metric equivalent (SIU) or vice versa. For the convenience of the readers around the world, this book provides detailed conversion factors and glossary terms for water resources engineers. In addition, the basic and supplementary units, the derived units and quantities, important physical constants, the properties of water, and the periodic table of the elements are also presented in this chapter [1–3].

Key Words Water resources engineering • Glossary • Conversion factors • Water resources engineers • Physical constants • Periodic table of the elements • Water properties

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1. CONSTANTS AND CONVERSION FACTORS

Multiply	*by*	*to obtain*
abamperes	10	amperes
abamperes	2.99796×10^{10}	statamperes
abampere-turns	12.566	gilberts
abcoulombs	10	coulombs (abs)
abcoulombs	2.99796×10^{10}	statcoulombs
abcoulombs/kg	30,577	statcoulombs/dyne
abfarads	1×10^{9}	farads (abs)
abfarads	8.98776×10^{20}	statfarads
abhenries	1×10^{-9}	henries (abs)
abhenries	1.11263×10^{-21}	stathenries
abohms	1×10^{-9}	ohms (abs)
abohms	1.11263×10^{-21}	statohms
abvolts	3.33560×10^{-11}	statvolts
abvolts	1×10^{-8}	volts (abs)
abvolts/centimeters	2.540005×10^{-8}	volts (abs)/inch
acres	0.4046	ha
acres	43,560	square feet
acres	4047	square meters
acres	1.562×10^{-3}	square miles
acres	4840	square yards
acre-feet	43,560	cubic feet
acre-feet	1233.5	cubic meters
acre-feet	325,850	gallons (U.S.)
amperes (abs)	0.1	abamperes
amperes (abs)	1.036×10^{-5}	faradays/second
amperes (abs)	2.9980×10^{9}	statamperes
ampere-hours (abs)	3600	coulombs (abs)
ampere-hours	0.03731	faradays
amperes/sq cm	6.452	amps/sq in
amperes/sq cm	10^{4}	amps/sq meter
amperes/sq in	0.1550	amps/sq cm
amperes/sq in	1550.0	amps/sq meter
amperes/sq meter	10^{-4}	amps/sq cm
amperes/sq meter	6.452×10^{-4}	amps/sq in
ampere-turns	1.257	gilberts
ampere-turns/cm	2.540	amp-turns/in
ampere-turns/cm	100.0	amp-turns/meter
ampere-turns/cm	1.257	gilberts/cm

(continued)

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Multiply	*by*	*to obtain*
ampere-turns/in	0.3937	amp-turns/cm
ampere-turns/in	39.37	amp-turns/meter
ampere-turns/in	0.4950	gilberts/cm
ampere-turns/meter	0.01	amp-turns/cm
ampere-turns/meter	0.0254	amp-turns/in
ampere-turns/meter	0.01257	gilberts/cm
angstrom units	1×10^{-8}	centimeters
angstrom units	3.937×10^{-9}	inches
angstrom unit	1×10^{-10}	meter
angstrom unit	1×10^{-4}	micron or μm
ares	0.02471	acre (U.S.)
ares	1076	square feet
ares	100	square meters
ares	119.60	sq yards
assay tons	29.17	grams
astronomical unit	1.495×10^{8}	kilometers
atmospheres (atm)	0.007348	tons/sq inch
atmospheres	76.0	cms of mercury
atmospheres	101.325	kN/m^2 (or kPa)
atmospheres	1.013	bar
atmospheres	1.01325×10^{6}	dynes/square centimeter
atmospheres	33.90	ft of water (at 4° C)
atmospheres	29.92	inches of mercury (at 0° C)
atmospheres	1.033228	kg/sq cm
atmospheres	10,332	kg/sq meter
atmospheres	760.0	millimeters of mercury
atmospheres	14.696	pounds/square inch
atmospheres	1.058	tons/sq foot
avograms	1.66036×10^{-24}	grams
bags, cement	94	pounds of cement
bar (pressure)	10^{5}	$Newton/m^2$
bar (pressure)	14.504	lb/sq in
bar (pressure)	100.657	kPa
barleycorns (British)	1/3	inches
barleycorns (British)	8.467×10^{-3}	meters
barrels (British, dry)	5.780	cubic feet
barrels (British, dry)	0.1637	cubic meters
barrels (British, dry)	36	gallons (British)
barrels, cement	170.6	kilograms
barrels, cement	376	pounds of cement

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Multiply	*by*	*to obtain*
barrels, cranberry	3.371	cubic feet
barrels, cranberry	0.09547	cubic meters
barrels, oil	5.615	cubic feet
barrels, oil	0.1590	cubic meters
barrels, oil	42	gallons (U.S.)
barrels, (U.S., dry)	4.083	cubic feet
barrels (U.S., dry)	7056	cubic inches
barrels (U.S., dry)	0.11562	cubic meters
barrels (U.S., dry)	105.0	quarts (dry)
barrels (U.S., liquid)	4.211	cubic feet
barrels (U.S., liquid)	0.1192	cubic meters
barrels (U.S., liquid)	31.5	gallons (U.S.)
bars	0.98692	atmospheres
bars	10^6	dynes/sq cm
bars	1.0197×10^4	kg/sq meter
bars	1000	millibar
bars	750.06	mm of Hg (0° C)
bars	2089	pounds/sq ft
bars	14.504	pounds/sq in
barye	1.000	dynes/sq cm
board feet	1/12	cubic feet
board feet	144 sq.in. $\times$ 1 in.	cubic inches
boiler horsepower	33,475	BTU (mean)/hour
boiler horsepower	34.5	pounds of water evaporated from and at 212° F (per hour)
bolts (U.S., cloth)	120	linear feet
bolts (U.S., cloth)	36.576	meters
bougie decimales	1	candles (int)
BTU (mean)	251.98	calories, gram (g. cal)
BTU (mean)	0.55556	centigrade heat units (chu)
BTU (mean)	1.0548×10^{10}	ergs
BTU (mean)	777.98	foot-pounds
BTU (mean)	3.931×10^{-4}	horsepower-hrs (hp-hr)
BTU (mean)	1055	joules (abs)
BTU (mean)	0.25198	kilograms, cal (kg cal)
BTU (mean)	107.565	kilogram-meters
BTU (mean)	2.928×10^{-4}	kilowatt-hr (Kwh)
BTU (mean)	10.409	liter-atm
BTU (mean)	6.876×10^{-5}	pounds of carbon to CO_2
BTU (mean)	0.29305	watt-hours
BTU (mean)/cu ft	37.30	joule/liter

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Multiply	*by*	*to obtain*
BTU/hour	0.2162	foot-pound/sec
BTU/hour	0.0700	gram-cal/sec
BTU/hour	3.929×10^{-4}	horsepower-hours (hp-hr)
BTU/hour	0.2930711	watt (w)
BTU/hour (feet)° F	1.730735	joule/sec (m)° k
BTU/hour (feet^2)	3.15459	joule/m^2-sec
BTU (mean)/hour(feet^2)° F	1.3562×10^{-4}	gram-calorie/second (cm^2)°C
BTU (mean)/hour(feet^2)° F	3.94×10^{-4}	horsepower/(ft^2)° F
BTU (mean)/hour(feet^2)° F	5.678264	joule/sec (m^2)° k
BTU (mean)/hour(feet^2)° F	4.882	kilogram-calorie/hr (m^2)° C
BTU (mean)/hour(feet^2)° F	5.682×10^{-4}	watts/(cm^2)° C
BTU (mean)/hour(feet^2)° F	2.035×10^{-3}	watts/(in^2)° C
BTU (mean)/(hour)(feet^2) (°F/inch)	3.4448×10^{-4}	calories, gram (15°C)/sec (cm^2) (°C/cm)
BTU (mean)/(hour)(feet^2) (°F/in.)	1	chu/(hr)(ft^2)(°C/in)
BTU (mean)/(hour)(feet^2) (°F/inch)	1.442×10^{-3}	joules (abs)/(sec)(cm^2) (°C/cm)
BTU(mean)/(hour)(feet^2) (°F/inch)	1.442×10^{-3}	watts/(cm^2) (° C/cm)
BTU/min	12.96	ft lb/sec
BTU/min	0.02356	hp
BTU/min	0.01757	kw
BTU/min	17.57	watts
BTU/min/ft^2	0.1221	watts/sq inch
BTU/pound	0.5556	calories-gram(mean)/gram
BTU/pound	0.555	kg-cal/kg
BTU/pound/°F	1	calories, gram/gram/°C
BTU/pound/°F	4186.8	joule/kg/°k
BTU/second	1054.350	watt (W)
buckets (British, dry)	1.818×10^4	cubic cm
buckets (British, dry)	4	gallons (British)
bushels (British)	1.03205	bushels (U.S.)
bushels (British)	1.2843	cubic feet
bushels (British)	0.03637	cubic meters
bushels (U.S.)	1.2444	cubic feet
bushels (U.S.)	2150.4	cubic inch
bushels (U.S.)	0.035239	cubic meters
bushels (U.S.)	35.24	liters (L)
bushels (U.S.)	4	pecks (U.S.)

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Multiply	*by*	*to obtain*
bushels (U.S.)	64	pints (dry)
bushels (U.S.)	32	quarts (dry)
butts (British)	20.2285	cubic feet
butts (British)	126	gallons (British)
cable lengths	720	feet
cable lengths	219.46	meters
calories (thermochemical)	0.999346	calories (Int. Steam Tables)
calories, gram (g. cal or simply cal.)	3.9685×10^{-3}	BTU (mean)
calories, gram (mean)	0.001459	cubic feet atmospheres
calories, gram (mean)	4.186×10^{7}	ergs
calories, gram (mean)	3.0874	foot-pounds
calories, gram (mean)	4.186	joules (abs)
calories, gram (mean)	0.001	kg cal (calories, kilogram)
calories, gram (mean)	0.42685	kilograms-meters
calories, gram (mean)	0.0011628	watt-hours
calories, gram (mean)/gram	1.8	BTU (mean)/pound
cal/gram-°C	4186.8	joule/kg °k
candle power (spherical)	12.566	lumens
candles (int)	0.104	carcel units
candles (int)	1.11	hefner units
candles (int)	1	lumens (int)/steradian
candles (int)/square centimeter	2919	foot-lamberts
candles (int)/square centimeter	3.1416	lamberts
candles (int)/square foot	3.1416	foot-lamberts
candles (int)/square foot	3.382×10^{-3}	lamberts
candles (int)/square inch	452.4	foot-lamberts
candles (int)/square inch	0.4870	lamberts
candles (int)/square inch	0.155	stilb
carats (metric)	3.0865	grains
carats (metric)	0.2	grams
centals	100	pounds
centares (centiares)	1.0	sq meters
centigrade heat units (chu)	1.8	BTU
centigrade heat units (chu)	453.6	calories, gram (15° C)
centigrade heat units (chu)	1897.8	joules (abs)
centigrams	0.01	grams
centiliters	0.01	liters
centimeters	0.0328083	feet (U.S.)
centimeters	0.3937	inches (U.S.)
centimeters	0.01	meters

(continued)

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Multiply	*by*	*to obtain*
centimeters	6.214×10^{-6}	miles
centimeters	10	millimeters
centimeters	393.7	mils
centimeters	0.01094	yards
cm of mercury	0.01316	atm
cm of mercury	0.4461	ft of water
cm of mercury	136.0	kg/square meter
cm of mercury	1333.22	newton/meter^2 (N/m^2)
cm of mercury	27.85	psf
cm of mercury	0.1934	psi
cm of water (4° C)	98.0638	newton/meter^2 (N/m^2)
centimeters-dynes	1.020×10^{-3}	centimeter-grams
centimeter-dynes	1.020×10^{-8}	meter-kilograms
centimeter-dynes	7.376×10^{-8}	pound-feet
centimeter-grams	980.7	centimeter-dynes
centimeter-grams	10^{-5}	meter-kilograms
centimeter-grams	7.233×10^{-5}	pound-feet
centimeters/second	1.969	fpm (ft/min)
centimeters/second	0.0328	fps (ft/sec)
centimeters/second	0.036	kilometers/hour
centimeters/second	0.1943	knots
centimeters/second	0.6	m/min
centimeters/second	0.02237	miles/hour
centimeters/second	3.728×10^{-4}	miles/minute
cms/sec./sec.	0.03281	feet/sec/sec
cms/sec./sec.	0.036	kms/hour/sec
cms/sec./sec.	0.02237	miles/hour/sec
centipoises	3.60	kilograms/meter hour
centipoises	10^{-3}	kilograms/meter second
centipoises	0.001	newton-sec/m^2
centipoises	2.089×10^{-5}	pound force second/square foot
centipoises	2.42	pounds/foot hour
centipoises	6.72×10^{-4}	pounds/foot second
centistoke	1.0×10^{-6}	meter^2/sec
chains (engineers' or Ramden's)	100	feet
chains (engineers' or Ramden's)	30.48	meters
chains (surveyors' or Gunter's)	66	feet
chains (surveyors' or Gunter's)	20.12	meters
chaldrons (British)	32	bushels (British)

(continued)

(continued)

Multiply	*by*	*to obtain*
chaldrons (U.S.)	36	bushels (U.S.)
cheval-vapours	0.9863	horsepower
cheval-vapours	735.5	watts (abs)
cheval-vapours heures	2.648×10^{6}	joules (abs)
chu/(hr)(ft^2)(C/in.)	1	BTU/(hr)(ft^2)(F/in.)
circular inches	0.7854	square inches
circular millimeters	7.854×10^{-7}	square meters
circular mils	5.067×10^{-6}	square centimeters
circular mils	7.854×10^{-7}	square inches
circular mils	0.7854	square mils
circumferences	360	degrees
circumferences	400	grades
circumferences	6.283	radians
cloves	8	pounds
coombs (British)	4	bushels (British)
cords	8	cord feet
cords	$8' \times 4' \times 4'$	cubic feet
cords	128	cubic feet
cords	3.625	cubic meters
cord-feet	$4' \times 4' \times 1'$	cubic feet
coulombs (abs)	0.1	abcoulombs
coulombs (abs)	6.281×10^{18}	electronic charges
coulombs (abs)	2.998×10^{9}	statcoulombs
coulombs (abs)	1.036×10^{-5}	faradays
coulombs/sq cm	64.52	coulombs/sq in
coulombs/sq cm	10^{4}	coulombs/sq meter
coulombs/sq in	0.1550	coulombs/sq cm
coulombs/sq in	1550	coulombs/sq meter
coulombs/sq meter	10^{-4}	coulombs/sq cm
coulombs/sq meter	6.452×10^{-4}	coulombs/sq in
cubic centimeters	3.531445×10^{-5}	cubic feet (U.S.)
cubic centimeters	6.102×10^{-2}	cubic inches
cubic centimeters	10^{-6}	cubic meters
cubic centimeters	1.308×10^{-6}	cubic yards
cubic centimeters	2.6417×10^{-4}	gallons (U.S.)
cubic centimeters	0.001	liters
cubic centimeters	0.033814	ounces (U.S., fluid)
cubic centimeters	2.113×10^{-3}	pints (liq.)
cubic centimeters	1.057×10^{-3}	quarts (liq.)

(continued)

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Multiply	*by*	*to obtain*
cubic feet (British)	0.9999916	cubic feet (U.S.)
cubic feet (U.S.)	0.8036	bushels (dry)
cubic feet (U.S.)	28317.016	cubic centimeters
cubic feet (U.S.)	1728	cubic inches
cubic feet (U.S.)	0.02832	cubic meters
cubic feet (U.S.)	0.0370	cubic yard
cubic feet (U.S.)	7.48052	gallons (U.S.)
cubic feet (U.S.)	28.31625	liters
cubic feet (U.S.)	59.84	pints (liq.)
cubic feet (U.S.)	29.92	quarts (liq.)
cubic feet of common brick	120	pounds
cubic feet of water (60° F)	62.37	pounds
cubic foot-atmospheres	2.7203	BTU (mean)
cubic foot-atmospheres	680.74	calories, gram (mean)
cubic foot-atmospheres	2116	foot-pounds
cubic foot-atmospheres	2869	joules (abs)
cubic foot-atmospheres	292.6	kilogram-meters
cubic foot-atmospheres	7.968×10^{-4}	kilowatt-hours
cubic feet/hr	0.02832	m^3/hr
cubic feet/minute	472.0	cubic cm/sec
cubic feet/minute	1.6992	cu m/hr
cubic feet/minute	0.0283	cu m/min
cubic feet/minute	0.1247	gallons/sec
cubic feet/minute	0.472	liter/sec
cubic feet/minute	62.4	lbs of water/min
cubic feet/min/1000 cu ft	0.01667	liter/sec/cu m
cubic feet/second	1.9834	acre-feet/day
cubic feet/second	1.7	cu m/min
cubic feet/second	0.02832	m^3/sec
cubic feet/second	448.83	gallons/minute
cubic feet/second	1699	liter/min
cubic feet/second	28.32	liters/sec
cubic feet/second (cfs)	0.64632	million gallons/day (MGD)
cfs/acre	0.07	m^3/sec-ha
cfs/acre	4.2	cu m/min/ha
cfs/sq mile	0.657	cu m/min/sq km
cubic inches (U.S.)	16.387162	cubic centimeters
cubic inches (U.S.)	5.787×10^{-4}	cubic feet
cubic inches (U.S.)	1.0000084	cubic inches (British)

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(continued)

Multiply	*by*	*to obtain*
cubic inches (U.S.)	1.639×10^{-5}	cubic meters
cubic inches (U.S.)	2.143×10^{-5}	cubic yards
cubic inches (U.S.)	4.329×10^{-3}	gallons (U.S.)
cubic inches (U.S.)	1.639×10^{-2}	liters
cubic inches (U.S.)	16.39	mL
cubic inches (U.S.)	0.55411	ounces (U.S., fluid)
cubic inches (U.S.)	0.03463	pints (liq.)
cubic inches (U.S.)	0.01732	quarts (liq.)
cubic meters	8.1074×10^{-4}	acre-feet
cubic meters	8.387	barrels (U.S., liquid)
cubic meters	28.38	bushels (dry)
cubic meters	10^6	cubic centimeters
cubic meters	35.314	cubic feet (U.S.)
cubic meters	61,023	cubic inches (U.S.)
cubic meters	1.308	cubic yards (U.S.)
cubic meters	264.17	gallons (U.S.)
cubic meters	1000	liters
cubic meters	2113	pints (liq.)
cubic meters (m^3)	1057	quarts (liq.)
cubic meters/day	0.183	gallons/min
cubic meters/ha	106.9	gallons/acre
cubic meters/hour	0.2272	gallons/minute
cubic meters/meter-day	80.53	gpd/ft
cubic meters/minute	35.314	cubic ft/minute
cubic meters/second	35.314	cubic ft/sec
cubic meters/second	22.82	MGD
cubic meters/sec-ha	14.29	cu ft/sec-acre
cubic meters/$meters^2$-day	24.54	gpd/ft^2
cubic yards (British)	0.9999916	cubic yards (U.S.)
cubic yards (British)	0.76455	cubic meters
cubic yards (U.S.)	7.646×10^5	cubic centimeters
cubic yards (U.S.)	27	cubic feet (U.S.)
cubic yards (U.S.)	46,656	cubic inches
cubic yards (U.S.)	0.76456	cubic meters
cubic yards (U.S.)	202.0	gallons (U.S.)
cubic yards (U.S.)	764.6	liters
cubic yards (U.S.)	1616	pints (liq.)
cubic yards (U.S.)	807.9	quarts (liq.)
cubic yards of sand	2700	pounds
cubic yards/minute	0.45	cubic feet/second

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Multiply	*by*	*to obtain*
cubic yards/minute	3.367	gallons/second
cubic yards/minute	12.74	liters/second
cubits	45.720	centimeters
cubits	1.5	feet
dalton	1.65×10^{-24}gram	
days	1440	minutes
days	86,400	seconds
days (sidereal)	86164	seconds (mean solar)
debye units (dipole moment)	10^{18}	electrostatic units
decigrams	0.1	grams
deciliters	0.1	liters
decimeters	0.1	meters
degrees (angle)	60	minutes
degrees (angle)	0.01111	quadrants
degrees (angle)	0.01745	radians
degrees (angle)	3600	seconds
degrees/second	0.01745	radians/seconds
degrees/second	0.1667	revolutions/min
degrees/second	0.002778	revoltuions/sec
degree Celsius	$^\circ F = (^\circ C \times 9/5) + 32$	Fahrenheit
degree Celsius	$^\circ K = ^\circ C + 273.15$	Kelvin
degree Fahrenheit	$^\circ C = (^\circ F - 32) \times 5/9$	Celsius
degree Fahrenheit	$^\circ K = (^\circ F + 459.67)/1.8$	Kelvin
degree Rankine	$^\circ K = ^\circ R/1.8$	Kelvin
dekagrams	10	grams
dekaliters	10	liters
dekameters	10	meters
drachms (British, fluid)	3.5516×10^{-6}	cubic meters
drachms (British, fluid)	0.125	ounces (British, fluid)
drams (apothecaries' or troy)	0.1371429	ounces (avoirdupois)
drams (apothecaries' or troy)	0.125	ounces (troy)
drams (U.S., fluid or apoth.)	3.6967	cubic cm
drams (avoirdupois)	1.771845	grams
drams (avoirdupois)	27.3437	grains
drams (avoirdupois)	0.0625	ounces
drams (avoirdupois)	0.00390625	pounds (avoirdupois)
drams (troy)	2.1943	drams (avoirdupois)
drams (troy)	60	grains
drams (troy)	3.8879351	grams
drams (troy)	0.125	ounces (troy)

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Multiply	*by*	*to obtain*
drams (U.S., fluid)	3.6967×10^{-6}	cubic meters
drams (U.S., fluid)	0.125	ounces (fluid)
dynes	0.00101972	grams
dynes	10^{-7}	joules/cm
dynes	10^{-5}	joules/meter (newtons)
dynes	1.020×10^{-6}	kilograms
dynes	1×10^{-5}	newton (N)
dynes	7.233×10^{-5}	poundals
dynes	2.24809×10^{-6}	pounds
dyne-centimeters (torque)	7.3756×10^{-8}	pound-feet
dynes/centimeter	1	ergs/square centimeter
dynes/centimeter	0.01	ergs/square millimeter
dynes/square centimeter	9.8692×10^{-7}	atmospheres
dynes/square centimeter	10^{-6}	bars
dynes/square centimeter	2.953×10^{-5}	inch of mercury at 0°C
dynes/square centimeter	4.015×10^{-4}	inch of water at 4°C
dynes/square centimeter	0.01020	kilograms/square meter
dynes/square centimeter	0.1	newtons/square meter
dynes/square centimeter	1.450×10^{-5}	pounds/square inch
electromagnetic fps units of magnetic permeability	0.0010764	electromagnetic cgs units of magnetic permeability
electromagnetic fps units of magnetic permeability	1.03382×10^{-18}	electrostatic cgs units of magnetic permeability
electromagnetic cgs units, of magnetic permeability	1.1128×10^{-21}	electrostatic cgs units of magnetic permeability
electromagnetic cgs units of mass resistance	9.9948×10^{-6}	ohms (int)-meter-gram
electronic charges	1.5921×10^{-19}	coulombs (abs)
electron-volts	1.6020×10^{-12}	ergs
electron-volts	1.0737×10^{-9}	mass units
electron-volts	0.07386	rydberg units of energy
electronstatic cgs units of Hall effect	2.6962×10^{31}	electromagnetic cgs units of Hall effect
electrostatic fps units of charge	1.1952×10^{-6}	coulombs (abs)
electrostatic fps units of magnetic permeability	929.03	electrostatic cgs units of magnetic permeability
ells	114.30	centimeters
ells	45	inches
ems, pica (printing)	0.42333	centimeters
ems, pica (printing)	1/6	inches

(continued)

(continued)

Multiply	*by*	*to obtain*
ergs	9.4805×10^{-11}	BTU (mean)
ergs	2.3889×10^{-8}	calories, gram (mean)
ergs	1	dyne-centimeters
ergs	7.3756×10^{-8}	foot-pounds
ergs	0.2389×10^{-7}	gram-calories
ergs	1.020×10^{-3}	gram-centimeters
ergs	3.7250×10^{-14}	horsepower-hrs
ergs	10^{-7}	joules (abs)
ergs	2.390×10^{-11}	kilogram-calories (kg cal)
ergs	1.01972×10^{-8}	kilogram-meters
ergs	0.2778×10^{-13}	kilowatt-hrs
ergs	0.2778×10^{-10}	watt-hours
ergs/second	5.692×10^{-9}	BTU/min
ergs/second	4.426×10^{-6}	foot-pounds/min
ergs/second	7.376×10^{-8}	foot-pounds/sec
ergs/second	1.341×10^{-10}	horsepower
ergs/second	1.434×10^{-9}	kg-calories/min
ergs/second	10^{-10}	kilowatts
farad (international of 1948)	0.9995	farad (F)
faradays	26.80	ampere-hours
faradays	96,500	coulombs (abs)
faradays/second	96,500	amperes (abs)
farads (abs)	10^{-9}	abfarads
farads (abs)	10^{6}	microfarads
farads (abs)	8.9877×10^{11}	statfarads
fathoms	6	feet
fathom	1.829	meter
feet (U.S.)	1.0000028	feet (British)
feet (U.S.)	30.4801	centimeters
feet (U.S.)	12	inches
feet (U.S.)	3.048×10^{-4}	kilometers
feet (U.S.)	0.30480	meters
feet (U.S.)	1.645×10^{-4}	miles (naut.)
feet (U.S.)	1.893939×10^{-4}	miles (statute)
feet (U.S.)	304.8	millimeters
feet (U.S.)	1.2×10^{4}	mils
feet (U.S.)	1/3	yards
feet of air (1 atmosphere,60 °F)	5.30×10^{-4}	pounds/square inch
feet of water	0.02950	atm
feet of water	0.8826	inches of mercury

(continued)

(continued)

Multiply	*by*	*to obtain*
feet of water at 39.2°F	0.030479	kilograms/square centimeter
feet of water at 39.2°F	2988.98	newton/meter^2 (N/m^2)
feet of water at 39.2°F	304.79	kilograms/square meter
feet of water	62.43	pounds/square feet (psf)
feet of water at 39.2°F	0.43352	pounds/square inch (psi)
feet/hour	0.08467	mm/sec
feet/min	0.5080	cms/sec
feet/min	0.01667	feet/sec
feet/min	0.01829	km/hr
feet/min	0.3048	meters/min
feet/min	0.01136	miles/hr
feet/sec	30.48	cm/sec
feet/sec	1.097	km/hr
feet/sec	0.5921	knots
feet/sec	18.29	meters/min
feet/sec	0.6818	miles/hr
feet/sec	0.01136	miles/min
feet/sec/sec	30.48	cm/sec/sec
feet/sec/sec	1.097	km/hr/sec
feet/sec/sec	0.3048	meters/sec/sec
feet/sec/sec	0.6818	miles/hr/sec
feet/100 feet	1.0	percent grade
firkins (British)	9	gallons (British)
firkins (U.S.)	9	gallons (U.S.)
foot-candle (ft-c)	10.764	lumen/sq m
foot-poundals	3.9951×10^{-5}	BTU (mean)
foot-poundals	0.0421420	joules (abs)
foot-pounds	0.0012854	BTU (mean)
foot-pounds	0.32389	calories, gram (mean)
foot-pounds	1.13558×10^{7}	ergs
foot-pounds	32.174	foot-poundals
foot-pounds	5.050×10^{-7}	hp-hr
foot-pounds	1.35582	joules (abs)
foot-pounds	3.241×10^{-4}	kilogram-calories
foot-pounds	0.138255	kilogram-meters
foot-pounds	3.766×10^{-7}	kwh
foot-pounds	0.013381	liter-atmospheres
foot-pounds	3.7662×10^{-4}	watt-hours (abs)
foot-pounds/minute	1.286×10^{-3}	BTU/minute
foot-pounds/minute	0.01667	foot-pounds/sec

(continued)

(continued)

Multiply	*by*	*to obtain*
foot-pounds/minute	3.030×10^{-5}	hp
foot-pounds/minute	3.241×10^{-4}	kg-calories/min
foot-pounds/minute	2.260×10^{-5}	kw
foot-pounds/second	4.6275	BTU (mean)/hour
foot-pounds/second	0.07717	BTU/minute
foot-pounds/second	0.0018182	horsepower
foot-pounds/second	0.01945	kg-calories/min
foot-pounds/second	0.001356	kilowatts
foot-pounds/second	1.35582	watts (abs)
furlongs	660.0	feet
furlongs	201.17	meters
furlongs	0.125	miles (U.S.)
furlongs	40.0	rods
gallons (Br.)	3.8125×10^{-2}	barrels (U.S.)
gallons (Br.)	4516.086	cubic centimeters
gallons (Br.)	0.16053	cu ft
gallons (Br.)	277.4	cu inches
gallons (Br.)	1230	drams (U.S. fluid)
gallons (Br.)	4.54596	liters
gallons (Br.)	7.9620×10^{4}	minims (Br.)
gallons (Br.)	7.3783×10^{4}	minims (U.S.)
gallons (Br.)	4545.96	mL
gallons (Br.)	1.20094	gallons (U.S.)
gallons (Br.)	160	ounces (Br., fl.)
gallons (Br.)	153.72	ounces (U.S., fl.)
gallons (Br.)	10	pounds (avoirdupois) of water at 62°F
gallons (U.S.)	3.068×10^{-4}	acre-ft
gallons (U.S.)	0.031746	barrels (U.S.)
gallons (U.S.)	3785.434	cubic centimeters
gallons (U.S.)	0.13368	cubic feet (U.S.)
gallons (U.S.)	231	cubic inches
gallons (U.S.)	3.785×10^{-3}	cubic meters
gallons (U.S.)	4.951×10^{-3}	cubic yards
gallons (U.S.)	1024	drams (U.S., fluid)
gallons (U.S.)	0.83268	gallons (Br.)
gallons (U.S.)	0.83267	imperial gal
gallons (U.S.)	3.78533	liters
gallons (U.S.)	6.3950×10^{4}	minims (Br.)
gallons (U.S.)	6.1440×10^{4}	minims (U.S.)

(continued)

(continued)

Multiply	*by*	*to obtain*
gallons (U.S.)	3785	mL
gallons (U.S.)	133.23	ounces (Br., fluid)
gallons (U.S.)	128	ounces (U.S., fluid)
gallons	8	pints (liq.)
gallons	4	quarts (liq.)
gal water (U.S.)	8.345	lb of water
gallons/acre	0.00935	cu m/ha
gallons/day	4.381×10^{-5}	liters/sec
gallons/ton	4.1721	liter/metric ton (L/T)
gpd/acre	0.00935	cu m/day/ha
gpd/acre	9.353	liter/day/ha
gallons/capita/day	3.785	liters/capita/day
gpd/cu yd	5.0	L/day/cu m
gpd/ft	0.01242	cu m/day/m
gpd/sq ft	0.0408	cu m/day/sq m
gpd/sq ft	1.698×10^{-5}	cubic meters/hour/sq meter
gpd/sq ft	0.283	cu meter/minute/ha
gpm (gal/min)	8.0208	cfh (cu ft/hr)
gpm	2.228×10^{-3}	cfs (cu ft/sec)
gpm	4.4021	cubic meters/hr
gpm	0.00144	MGD
gpm	0.0631	liters/sec
gpm/sq ft	2.445	cu meters/hour/sq meter
gpm/sq ft	40.7	L/min/sq meter
gpm/sq ft	0.679	liter/sec/sq meter
gallons/sq ft	40.743	liters/sq meter
gausses (abs)	3.3358×10^{-4}	electrostatic cgs units of magnetic flux density
gausses (abs)	0.99966	gausses (int)
gausses (abs)	1	lines/square centimeter
gausses (abs)	6.452	lines/sq in
gausses (abs)	1	maxwells (abs)/square centimeters
gausses (abs)	6.4516	maxwells (abs)/square inch
gausses (abs)	10^{-8}	webers/sq cm
gausses (abs)	6.452×10^{-8}	webers/sq in
gausses (abs)	10^{-4}	webers/sq meter
gilberts (abs)	0.07958	abampere turns
gilberts (abs)	0.7958	ampere turns
gilberts (abs)	2.998×10^{10}	electrostatic cgs units of magneto motive force

(continued)

(continued)

Multiply	*by*	*to obtain*
gilberts/cm	0.7958	amp-turns/cm
gilberts/cm	2.021	amp-turns/in
gilberts/cm	79.58	amp-turns/meter
gills (Br.)	142.07	cubic cm
gills (Br.)	5	ounces (British, fluid)
gills (U.S.)	32	drams (fluid)
gills	0.1183	liters
gills	0.25	pints (liq.)
grade	0.01571	radian
grains	0.036571	drams (avoirdupois)
grains	0.01667	drams (troy)
grains (troy)	1.216	grains (avdp)
grains (troy)	0.06480	grams
grains (troy)	6.480×10^{-5}	kilograms
grains (troy)	64.799	milligrams
grains (troy)	2.286×10^{-3}	ounces (avdp)
grains (troy)	2.0833×10^{-3}	ounces (troy)
grains (troy)	0.04167	pennyweights (troy)
grains	1/7000	pounds (avoirdupois)
grains	1.736×10^{-4}	pounds (troy)
grains	6.377×10^{-8}	tons (long)
grains	7.142×10^{-8}	tons (short)
grains/imp gal	14.254	mg/L
grains/imp. gal	14.254	parts/million (ppm)
grains/U.S. gal	17.118	mg/L
grains/U.S. gal	17.118	parts/million (ppm)
grains/U.S. gal	142.86	lb/mil gal
grams	0.5611	drams (avdp)
grams	0.25721	drams (troy)
grams	980.7	dynes
grams	15.43	grains
grams	9.807×10^{-5}	joules/cm
grams	9.807×10^{-3}	joules/meter (newtons)
grams	10^{-3}	kilograms
grams	10^{3}	milligrams
grams	0.0353	ounces (avdp)
grams	0.03215	ounces (troy)
grams	0.07093	poundals
grams	2.205×10^{-3}	pounds

(continued)

(continued)

Multiply	*by*	*to obtain*
grams	2.679×10^{-3}	pounds (troy)
grams	9.842×10^{-7}	tons (long)
grams	1.102×10^{-6}	tons (short)
grams-calories	4.1868×10^{7}	ergs
gram-calories	3.0880	foot-pounds
gram-calories	1.5597×10^{-6}	horsepower-hr
gram-calories	1.1630×10^{-6}	kilowatt-hr
gram-calories	1.1630×10^{-3}	watt-hr
gram-calories	3.968×10^{-3}	British Thermal Units (BTU)
gram-calories/sec	14.286	BTU/hr
gram-centimeters	9.2967×10^{-8}	BTU (mean)
gram-centimeters	2.3427×10^{-5}	calories, gram (mean)
gram-centimeters	980.7	ergs
gram-centimeters	7.2330×10^{-5}	foot-pounds
gram-centimeters	9.8067×10^{-5}	joules (abs)
gram-centimeters	2.344×10^{-8}	kilogram-calories
gram-centimeters	10^{-5}	kilogram-meters
gram-centimeters	2.7241×10^{-8}	watt-hours
grams-centimeters^2 (moment of inertia)	2.37305×10^{-6}	pounds-feet^2
grams-centimeters^2 (moment of inertia)	3.4172×10^{-4}	pounds-inch^2
gram-centimeters/second	1.3151×10^{-7}	hp
gram-centimeters/second	9.8067×10^{-8}	kilowatts
gram-centimeters/second	0.065552	lumens
gram-centimeters/second	9.80665×10^{-5}	watt (abs)
grams/cm	5.600×10^{-3}	pounds/inch
grams/cu cm	62.428	pounds/cubic foot
grams/cu cm	0.03613	pounds/cubic inch
grams/cu cm	8.3454	pounds/gallon (U.S.)
grams/cu cm	3.405×10^{-7}	pounds/mil-foot
grams/cu ft	35.314	grams/cu meter
grams/cu ft	10^{6}	micrograms/cu ft
grams/cu ft	35.314×10^{6}	micrograms/cu meter
grams/cu ft	35.3145×10^{3}	milligrams/cu meter
grams/cu ft	2.2046	pounds/1000 cu ft
grams/cu m	0.43700	grains/cubic foot
grams/cu m	0.02832	grams/cu ft
grams/cu m	28.317×10^{3}	micrograms/cu ft
grams/cu m	0.06243	pounds/cu ft

(continued)

(continued)

Multiply	*by*	*to obtain*
grams/liter	58.417	grains/gallon (U.S.)
grams/liter	9.99973×10^{-4}	grams/cubic centimeter
grams/liter	1000	mg/L
grams/liter	1000	parts per million (ppm)
grams/liter	0.06243	pounds/cubic foot
grams/liter	8.345	lb/1000 gal
grams/sq centimeter	2.0481	pounds/sq ft
grams/sq centimeter	0.0142234	pounds/square inch
grams/sq ft	10.764	grams/sq meter
grams/sq ft	10.764×10^{3}	kilograms/sq km
grams/sq ft	1.0764	milligrams/sq cm
grams/sq ft	10.764×10^{3}	milligrams/sq meter
grams/sq ft	96.154	pounds/acre
grams/sq ft	2.204	pounds/1000 sq ft
grams/sq ft	30.73	tons/sq mile
grams/sq meter	0.0929	grams/sq ft
grams/sq meter	1000	kilograms/sq km
grams/sq meter	0.1	milligrams/square cm
grams/sq meter	1000	milligrams/sq meter
grams/sq meter	8.921	pounds/acre
grams/sq meter	0.2048	pounds/1000 sq ft
grams/sq meter	2.855	tons/sq mile
g (gravity)	9.80665	meters/sec^2
g (gravity)	32.174	ft/sec^2
hand	10.16	cm
hands	4	inches
hectare (ha)	2.471	acre
hectares	1.076×10^{5}	sq feet
hectograms	100	grams
hectoliters	100	liters
hectometers	100	meters
hectowatts	100	watts
hemispheres	0.5	spheres
hemispheres	4	spherical right angles
hemispheres	6.2832	steradians
henries (abs)	10^{9}	abhenries
henries	1000.0	millihenries
henries (abs)	1.1126×10^{-12}	stathenries
hogsheads (British)	63	gallons (British)
hogsheads (British)	10.114	cubic feet

(continued)

(continued)

Multiply	*by*	*to obtain*
hogsheads (U.S.)	8.422	cubic feet
hogsheads (U.S.)	0.2385	cubic meters
hogsheads (U.S.)	63	gallons (U.S.)
horsepower	2545.08	BTU (mean)/hour
horsepower	42.44	BTU/min
horsepower	7.457×10^9	erg/sec
horsepower	33,000	ft lb/min
horsepower	550	foot-pounds/second
horsepower	7.6042×10^6	g cm/sec
horsepower, electrical	1.0004	horsepower
horsepower	10.70	kg.-calories/min
horsepower	0.74570	kilowatts (g = 980.665)
horsepower	498129	lumens
horsepower, continental	736	watts (abs)
horsepower, electrical	746	watts (abs)
horsepower (boiler)	9.803	kw
horsepower (boiler)	33.479	BTU/hr
horsepower-hours	2545	BTU (mean)
horsepower-hours	2.6845×10^{13}	ergs
horsepower-hours	6.3705×10^7	ft poundals
horsepower-hours	1.98×10^6	foot-pounds
horsepower-hours	641,190	gram-calories
horsepower-hours	2.684×10^6	joules
horsepower-hours	641.7	kilogram-calories
horsepower-hours	2.737×10^5	kilogram-meters
horsepower-hours	0.7457	kilowatt-hours (abs)
horsepower-hours	26,494	liter atmospheres (normal)
horsepower-hours	745.7	watt-hours
horsepower/1000 ft^3	0.0263	kw/m^3
hours	4.167×10^{-2}	days
hours	60	minutes
hours	3600	seconds
hours	5.952×10^{-3}	weeks
hundredweights (long)	112	pounds
hundredweights (long)	0.05	tons (long)
hundredweights (short)	1600	ounces (avoirdupois)
hundredweights (short)	100	pounds
hundredweights (short)	0.0453592	tons (metric)
hundredweights (short)	0.0446429	tons (long)

(continued)

(continued)

Multiply	*by*	*to obtain*
inches (British)	2.540	centimeters
inches (U.S.)	2.54000508	centimeters
inches (British)	0.9999972	inches (U.S.)
inches	2.540×10^{-2}	meters
inches	1.578×10^{-5}	miles
inches	25.40	millimeters
inches	10^{3}	mils
inches	2.778×10^{-2}	yards
inches^2	6.4516×10^{-4}	meter^2
inches^3	1.6387×10^{-5}	meter^3
in. of mercury	0.0334	atm
in. of mercury	1.133	ft of water
in. of mercury (0°C)	13.609	inches of water (60 °F)
in. of mercury	0.0345	kgs/square cm
in. of mercury at 32°F	345.31	kilograms/square meter
in. of mercury	33.35	millibars
in. of mercury	25.40	millimeters of mercury
in. of mercury (60°F)	3376.85	newton/meter^2
in. of mercury	70.73	pounds/square ft
in. of mercury at 32°F	0.4912	pounds/square inch
in. of water	0.002458	atmospheres
in. of water	0.0736	in. of mercury
in. of water (at 4°C)	2.540×10^{-3}	kgs/sq cm
in. of water	25.40	kgs/square meter
in. of water (60°F)	1.8663	millimeters of mercury (0°C)
in. of water (60°F)	248.84	newton/meter^2
in. of water	0.5781	ounces/square in
in. of water	5.204	pounds/square ft
in. of water	0.0361	psi
inches/hour	2.54	cm/hr
international ampere	.9998	ampere (absolute)
international volt	1.0003	volts (absolute)
international volt	1.593×10^{-19}	joules (absolute)
international volt	9.654×10^{4}	joules
joules	9.480×10^{-4}	BTU
joules (abs)	10^{7}	ergs
joules	23.730	foot poundals
joules (abs)	0.73756	foot-pounds
joules	3.7251×10^{-7}	horsepower hours
joules	2.389×10^{-4}	kg-calories

(continued)

(continued)

Multiply	*by*	*to obtain*
joules (abs)	0.101972	kilogram-meters
joules	9.8689×10^{-3}	liter atmospheres (normal)
joules	2.778×10^{-4}	watt-hrs
joules-sec	1.5258×10^{33}	quanta
joules/cm	1.020×10^{4}	grams
joules/cm	10^{7}	dynes
joules/cm	100.0	joules/meter (newtons)
joules/cm	723.3	poundals
joules/cm	22.48	pounds
joules/liter	0.02681	BTU/cu ft
joules/m^2-sec	0.3167	BTU/ft^2-hr
joules/sec	3.41304	BTU/hr
joules/sec	0.056884	BTU/min
joules/sec	1×10^{7}	erg/sec
joules/sec	44.254	ft lb/min
joules/sec	0.73756	ft lb/sec
joules/sec	1.0197×10^{4}	g cm/sec
joules/sec	1.341×10^{-3}	hp
joules/sec	0.01433	kg cal/min
joules/sec	0.001	kilowatts
joules/sec	668	lumens
joules/sec	1	watts
kilograms	564.38	drams (avdp)
kilograms	257.21	drams (troy)
kilograms	980,665	dynes
kilograms	15,432	grains
kilograms	1000	grams
kilograms	0.09807	joules/cm
kilograms	9.807	joules/meter (newtons)
kilograms	1×10^{6}	milligrams
kilograms	35.274	ounces (avdp)
kilograms	32.151	ounces (troy)
kilograms	70.93	poundals
kilograms	2.20462	pounds (avdp)
kilograms	2.6792	pounds (troy)
kilograms	9.84207×10^{-4}	tons (long)
kilograms	0.001	tons (metric)
kilograms	0.0011023	tons (short)
kilogram-calories	3.968	British Thermal Units (BTU)
kilogram-calories	3086	foot-pounds

(continued)

(continued)

Multiply	*by*	*to obtain*
kilogram-calories	1.558×10^{-3}	horsepower-hours
kilogram-calories	4186	joules
kilogram-calories	426.6	kilogram-meters
kilogram-calories	4.186	kilojoules
kilogram-calories	1.162×10^{-3}	kilowatt-hours
kg-cal/min	238.11	BTU/hr
kg-cal/min	3.9685	BTU/min
kg-cal/min	6.9770×10^{8}	erg/sec
kg-cal/min	3087.4	ft-lb/min
kg-cal/min	51.457	ft-lb/sec
kg-cal/min	7.1146×10^{5}	g cm/sec
kg-cal/min	0.0936	hp
kg-cal/min	69.769	joules/sec
kg-cal/min	0.0698	kw
kg-cal/min	46636	lumens
kg-cal/min	69.767	watts
kgs-cms. squared	2.373×10^{-3}	pounds-feet squared
kgs-cms. squared	0.3417	pounds-inches squared
kilogram-force (kgf)	9.80665	newton
kilogram-meters	0.0092967	BTU (mean)
kilogram-meters	2.3427	calories, gram (mean)
kilogram-meters	9.80665×10^{7}	ergs
kilogram-meters	232.71	ft poundals
kilogram-meters	7.2330	foot-pounds
kilogram-meters	3.6529×10^{-6}	horsepower-hours
kilogram-meters	9.80665	joules (abs)
kilogram-meters	2.344×10^{-3}	kilogram-calories
kilogram-meters	2.52407×10^{-6}	kilowatt-hours (abs)
kilogram-meters	2.7241×10^{-6}	kilowatt-hours
kilogram-meters	0.096781	liter atmospheres (normal)
kilogram-meters	6.392×10^{-7}	pounds carbon to CO_2
kilogram-meters	9.579×10^{-6}	pounds water evap. at 212
kilograms/cubic meter	10^{-3}	grams/cubic cm
kilograms/cubic meter	0.06243	pounds/cubic foot
kilograms/cubic meter	3.613×10^{-5}	pounds/cubic inch
kilograms/cubic meter	3.405×10^{-10}	pounds/mil. foot
kilograms/m^3-day	0.0624	lb/cu ft-day
kilograms/cu meter-day	62.43	pounds/1000 cu ft-day
kilograms/ha	0.8921	pounds/acre
kilograms/meter	0.6720	pounds/foot

(continued)

(continued)

Multiply	*by*	*to obtain*
kilograms/sq cm	980,665	dynes
kilograms/sq cm	0.96784	atmosphere
kilograms/sq cm	32.81	feet of water
kilograms/sq cm	28.96	inches of mercury
kilograms/sq cm	735.56	mm of mercury
kilograms/sq cm	2048	pounds/sq ft
kilograms/sq cm	14.22	pounds/square inch
kilograms/sq km	92.9×10^{-6}	grams/sq ft
kilograms/sq km	0.001	grams/sq meter
kilograms/sq km	0.0001	milligrams/sq cm
kilograms/sq km	1.0	milligrams/sq meter
kilograms/sq km	8.921×10^{-3}	pounds/acre
kilograms/sq km	204.8×10^{-6}	pounds/1000 sq ft
kilograms/sq km	2.855×10^{-3}	tons/sq mile
kilograms/sq meter	9.6784×10^{-5}	atmospheres
kilograms/sq meter	98.07×10^{-6}	bars
kilograms/sq meter	98.0665	dynes/sq centimeters
kilograms/sq meter	3.281×10^{-3}	feet of water at 39.2° F
kilograms/sq meter	0.1	grams/sq centimeters
kilograms/sq meter	2.896×10^{-3}	inches of mercury at 32°F
kilograms/sq meter	0.07356	mm of mercury at 0°C
kilograms/sq meter	0.2048	pounds/square foot
kilograms/sq meter	0.00142234	pounds/square inch
kilograms/sq mm.	10^6	kg/square meter
kilojoule	0.947	BTU
kilojoules/kilogram	0.4295	BTU/pound
kilolines	1000.0	maxwells
kiloliters	10^3	liters
kilometers	10^5	centimeters
kilometers	3281	feet
kilometers	3.937×10^4	inches
kilometers	10^3	meters
kilometers	0.53961	miles (nautical)
kilometers	0.6214	miles (statute)
kilometers	10^6	millimeters
kilometers	1093.6	yards
kilometers/hr	27.78	cm/sec
kilometers/hr	54.68	feet/minute
kilometers/hr	0.9113	ft/sec

(continued)

(continued)

Multiply	*by*	*to obtain*
kilometers/hr	0.5396	knot
kilometers/hr	16.67	meters/minute
kilometers/hr	0.2778	meters/sec
kilometers/hr	0.6214	miles/hour
kilometers/hour/sec	27.78	cms/sec/sec
kilometers/hour/sec	0.9113	ft/sec/sec
kilometers/hour/sec	0.2778	meters/sec/sec
kilometers/hour/sec	0.6214	miles/hr/sec
kilometers/min	60	kilometers/hour
kilonewtons/sq m	0.145	psi
kilopascal (kPa)	1	kN/m^2
kilopascal (kPa)	0.2691	in Hg (60°F)
kilopascal (kPa)	0.145	lb/in^2
kilopascal (kPa)	0.0099	atm
kilowatts	56.88	BTU/min
kilowatts	4.425×10^4	foot-pounds/min
kilowatts	737.6	ft-lb/sec
kilowatts	1.341	horsepower
kilowatts	14.34	kg-cal/min
kilowatts	10^3	watts
kilowatt-hrs	3413	BTU (mean)
kilowatt-hrs	3.600×10^{13}	ergs
kilowatt-hrs	2.6552×10^6	foot-pounds
kilowatt-hrs	859,850	gram-calories
kilowatt-hrs	1.341	horsepower hours
kilowatt-hrs	3.6×10^6	joules
kilowatt-hrs	860.5	kg-calories
kilowatt-hrs	3.6709×10^5	kilogram-meters
kilowatt-hrs	3.53	pounds of water evaporated from and at 212°F
kilowatt-hrs	22.75	pounds of water raised from 62° to 212°F
knots	6080	feet/hr
knots	1.689	feet/sec
knots	1.8532	kilometers/hr
knots	0.5144	meters/sec
knots	1.0	miles (nautical)/hour
knots	1.151	miles (statute)/hour
knots	2,027	yards/hr
lambert	2.054	$candle/in^2$
lambert	929	footlambert
lambert	0.3183	stilb

(continued)

(continued)

Multiply	*by*	*to obtain*
langley	1	15° gram-calorie/cm^2
langley	3.6855	BTU/ft^2
langley	0.011624	Int. kw-hr/m^2
langley	4.1855	joules (abs)/cm^2
leagues (nautical)	3	miles (nautical)
leagues (statute)	3	miles (statute)
light years	63,274	astronomical units
light years	9.4599×10^{12}	kilometers
light years	5.8781×10^{12}	miles
lignes (Paris lines)	1/12	ponces (Paris inches)
lines/sq cm	1.0	gausses
lines/sq in	0.1550	gausses
lines/sq in	1.550×10^{-9}	Webers/sq cm
lines/sq in	10^{-8}	Webers/sq in
lines/sq in	1.550×10^{-5}	Webers/sq meter
links (engineer's)	12.0	inches
links (Gunter's)	0.01	chains (Gunter's)
links (Gunter's)	0.66	feet
links (Ramden's)	0.01	chains (Ramden's)
links (Ramden's)	1	feet
links(surveyor's)	7.92	inches
liters	8.387×10^{-3}	barrels (U.S.)
liters	0.02838	bushels (U.S. dry)
liters	1000.028	cubic centimeters
liters	0.035316	cubic feet
liters	61.025	cu inches
liters	10^{-3}	cubic meters
liters	1.308×10^{-3}	cubic yards
liters	270.5179	drams (U.S. fl)
liters	0.21998	gallons (Br.)
liters	0.26417762	gallons (U.S.)
liters	16,894	minims (Br.)
liters	16,231	minims (U.S.)
liters	35.196	ounces (Br. fl)
liters	33.8147	ounces (U.S. fl)
liters	2.113	pints (liq.)
liters	1.0566828	quarts (U.S. liq.)
liter-atmospheres (normal)	0.096064	BTU (mean)
liter-atmospheres (normal)	24.206	calories, gram (mean)
liter-atmospheres (normal)	1.0133×10^{9}	ergs

(continued)

(continued)

Multiply	*by*	*to obtain*
liter-atmospheres (normal)	74.735	foot-pounds
liter-atmospheres (normal)	3.7745×10^{-5}	horsepower hours
liter-atmospheres (normal)	101.33	joules (abs)
liter-atmospheres (normal)	10.33	kilogram-meters
liter-atmospheres (normal)	2.4206×10^{-2}	kilogram calories
liter-atmospheres (normal)	2.815×10^{-5}	kilowatt-hours
liter/cu m-sec	60.0	cfm/1000 cu ft
liters/minute	5.885×10^{-4}	cubic feet/sec
liters/minute	4.403×10^{-3}	gallons/sec
liter/person-day	0.264	gpcd
liters/sec	2.119	cu ft/min
liters/sec	3.5316×10^{-2}	cu ft/sec
liters/sec	15.85	gallons/minute
liters/sec	0.02282	MGD
$\log_{10}$N	2.303	$\log_e$N or ln N
$\log_e$ N or ln N	0.4343	$\log_{10}$ N
lumens	0.07958	candle-power (spherical)
lumens	0.00147	watts of maximum visibility radiation
lumens/sq. centimeters	1	lamberts
lumens/sq cm/steradian	3.1416	lamberts
lumens/sq ft	1	foot-candles
lumens/sq ft	10.764	lumens/sq meter
lumens/sq ft/steradian	3.3816	millilamberts
lumens/sq meter	0.09290	foot-candles or lumens/sq
lumens/sq meter	10^{-4}	phots
lux	0.09290	foot-candles
lux	1	lumens/sq meter
lux	10^{-4}	phots
maxwells	0.001	kilolines
maxwells	10^{-8}	webers
megajoule	0.3725	horsepower-hour
megalines	10^6	maxwells
megohms	10^{12}	microhms
megohms	10^6	ohms
meters	10^{10}	angstrom units
meters	100	centimeters
meters	0.5467	fathoms
meters	3.280833	feet (U.S.)
meters	39.37	inches

(continued)

(continued)

Multiply	*by*	*to obtain*
meters	10^{-3}	kilometers
meters	5.396×10^{-4}	miles (naut.)
meters	6.2137×10^{-4}	miles (statute)
meters	10^{3}	millimeters
meters	10^{9}	millimicrons
meters	1.09361	yards (U.S.)
meters	1.179	varas
meter head of water (20°C)	9.79	kN/m^2
meter head of water (20°C)	0.00979	N/mm^2
meter head of water (20°C)	1.42	pound/sq in
meter-candles	1	lumens/sq meter
meter-kilograms	9.807×10^{7}	centimeter-dynes
meter-kilograms	10^{5}	centimeter-grams
meter-kilograms	7.233	pound-feet
meters/minute	1.667	centimeters/sec
meters/minute	3.281	feet/minute
meters/minute	0.05468	feet/second
meters/minute	0.06	kilograms/hour
meters/minute	0.03238	knots
meters/minute	0.03728	miles/hour
meters/second	196.8	feet/minute
meters/second	3.281	feet/second
meters/second	3.6	kilometers/hour
meters/second	0.06	kilometers/min
meters/second	1.944	knots
meters/second	2.23693	miles/hour
meters/second	0.03728	miles/minute
meters/sec/sec	100.0	cm/sec/sec
meters/sec/sec	3.281	feet/sec/sec
meters/sec/sec	3.6	km/hour/sec
meters/sec/sec	2.237	miles/hour/sec
microfarad	10^{-6}	farads
micrograms	10^{-6}	grams
micrograms/cu ft	10^{-6}	grams/cu ft
micrograms/cu ft	35.314×10^{-6}	grams/cu m
micrograms/cu ft	35.314	microgram/cu m
micrograms/cu ft	35.314×10^{-3}	milligrams/cu m
micrograms/cu ft	2.2046×10^{-6}	pounds/1000 cu ft
micrograms/cu m	28.317×10^{-9}	grams/cu ft
micrograms/cu m	10^{-6}	grams/cu m

(continued)

(continued)

Multiply	*by*	*to obtain*
micrograms/cu m	0.02832	micrograms/cu ft
micrograms/cu m	0.001	milligrams/cu m
micrograms/cu m	62.43×10^{-9}	pounds/1000 cu ft
micrograms/cu m	$\frac{0.02404}{\text{molecular weight of gas}}$	ppm by volume (20°C)
micrograms/cu m	834.7×10^{-6}	ppm by weight
micrograms/liter	1000.0	micrograms/cu m
micrograms/liter	1.0	milligrams/cu m
micrograms/liter	62.43×10^{-9}	pounds/cu ft
micrograms/liter	$\frac{24.04}{\text{molecular weight of gas}}$	ppm by volume (20°C)
micrograms/liter	0.834.7	ppm by weight
microhms	10^{-12}	megohms
microhms	10^{-6}	ohms
microliters	10^{-6}	liters
microns	10^{4}	angstrom units
microns	1×10^{-4}	centimeters
microns	3.9370×10^{-5}	inches
microns	10^{-6}	meters
miles (naut.)	6080.27	feet
miles (naut.)	1.853	kilometers
miles (naut.)	1.853	meters
miles (naut.)	1.1516	miles (statute)
miles (naut.)	2027	yards
miles (statute)	1.609×10^{5}	centimeters
miles (statute)	5280	feet
miles (statute)	6.336×10^{4}	inches
miles (statute)	1.609	kilometers
miles (statute)	1609	meters
miles (statute)	0.8684	miles (naut.)
miles (statute)	320	rods
miles (statute)	1760	yards
miles/hour	44.7041	centimeter/second
miles/hour	88	feet/min
miles/hour	1.4667	feet/sec
miles/hour	1.6093	kilometers/hour
miles/hour	0.02682	km/min
miles/hour	0.86839	knots
miles/hour	26.82	meters/min
miles/hour	0.447	meters/sec
miles/hour	0.1667	miles/min

(continued)

(continued)

Multiply	*by*	*to obtain*
miles/hour/sec	44.70	cms/sec/sec
miles/hour/sec	1.4667	ft/sec/sec
miles/hour/sec	1.6093	km/hour/sec
miles/hour/sec	0.4470	m/sec/sec
miles/min	2682	centimeters/sec
miles/min	88	ft/sec
miles/min	1.609	km/min
miles/min	0.8684	knots/min
miles/min	60	miles/hour
miles-feet	9.425×10^{-6}	cu inches
millibars	0.00987	atmospheres
millibars	0.30	inches of mercury
millibars	0.75	millimeters of mercury
milliers	10^3	kilograms
millimicrons	1×10^{-9}	meters
milligrams	0.01543236	grains
milligrams	10^{-3}	grams
milligrams	10^{-6}	kilograms
milligrams	3.5274×10^{-5}	ounces (avdp)
milligrams	2.2046×10^{-6}	pounds (avdp)
milligrams/assay ton	1	ounces (troy)/ton (short)
milligrams/cu m	283.2×10^6	grams/cu ft
milligrams/cu m	0.001	grams/cu m
milligrams/cu m	1000.0	micrograms/cu m
milligrams/cu m	28.32	micrograms/cu ft
milligrams/cu m	1.0	micrograms/liter
milligrams/cu m	62.43×10^{-6}	pounds/1000 cu ft
milligrams/cu m	$\frac{24.04}{\text{molecular weight of gas}}$	ppm by volume (20°C)
milligrams/cu m	0.8347	ppm by weight
milligrams/joule	5.918	pounds/horsepower-hour
milligrams/liter	0.05841	grains/gallon
milligrams/liter	0.07016	grains/imp. gal
milligrams/liter	0.0584	grains/U.S. gal
milligrams/liter	1.0	parts/million
milligrams/liter	8.345	lb/mil gal
milligrams/sq cm	0.929	grams/sq ft
milligrams/sq cm	10.0	grams/sq meter
milligrams/sq cm	10^4	kilograms/sq km
milligrams/sq cm	10^4	milligrams/sq meter

(continued)

(continued)

Multiply	*by*	*to obtain*
milligrams/sq cm	2.048	pounds/1000 sq ft
milligrams/sq cm	89.21	pounds/acre
milligrams/sq cm	28.55	tons/sq mile
milligrams/sq meter	92.9×10^{-6}	grams/sq ft
milligrams/sq meter	0.001	grams/sq meter
milligrams/sq meter	1.0	kilograms/sq km
milligrams/sq meter	0.0001	milligrams/sq cm
milligrams/sq meter	8.921×10^{-3}	pounds/acre
milligrams/sq meter	204.8×10^{-6}	pounds/1000 sq ft
milligrams/sq meter	2.855×10^{-3}	tons/sq mile
millihenries	0.001	henries
milliters	1	cubic centimeters
milliliters	3.531×10^{-5}	cu ft
milliliters	6.102×10^{-2}	cu in
milliliters	10^{-6}	cu m
milliliters	2.642×10^{-4}	gal (U.S.)
milliliters	10^{-3}	liters
milliliters	0.03381	ounces (U.S. fl)
millimeters	0.1	centimeters
millimeters	3.281×10^{-3}	feet
millimeters	0.03937	inches
millimeters	10^{-6}	kilometers
millimeters	0.001	meters
millimeters	6.214×10^{-7}	miles
millimeters	39.37	mils
millimeters	1.094×10^{-3}	yards
millimeters of mercury	1.316×10^{-3}	atmospheres
millimeters of mercury	0.0394	inches of mercury
millimeters of mercury (0°C)	0.5358	inches of water (60°F)
millimeters of mercury	1.3595×10^{-3}	kg/sq cm
millimeter of mercury (0°C)	133.3224	newton/meter^2
millimeters of mercury	0.01934	pounds/sq in
millimeters/sec	11.81	feet/hour
million gallons	306.89	acre-ft
million gallons	3785.0	cubic meters
million gallons	3.785	mega liters (1×10^6)
million gallons/day (MGD)	1.547	cu ft/sec
MGD	3785	cu m/day
MGD	0.0438	cubic meters/sec
MGD	43.808	liters/sec

(continued)

(continued)

Multiply	*by*	*to obtain*
MGD/acre	9360	cu m/day/ha
MGD/acre	0.039	cu meters/hour/sq meter
mils	0.002540	centimeters
mils	8.333×10^{-5}	feet
mils	0.001	inches
mils	2.540×10^{-8}	kilometers
mils	25.40	microns
mils	2.778×10^{-5}	yards
miner's in.	1.5	cu ft/min
miner's inches (Ariz., Calif. Mont., and Ore.)	0.025	cubic feet/second
miner's in. (Colorado)	0.02604	cubic feet/second
miner's inches (Idaho, Kan., Neb., Nev., N. Mex., N. Dak., S.Dak. and Utah)	0.020	cubic feet/second
minims (British)	0.05919	cubic centimeter
minims (U.S.)	0.06161	cubic centimeters
minutes (angles)	0.01667	degrees
minutes (angles)	1.852×10^{-4}	quadrants
minutes (angles)	2.909×10^{-4}	radians
minutes (angle)	60	seconds (angle)
months (mean calendar)	30.4202	days
months (mean calendar)	730.1	hours
months (mean calendar)	43805	minutes
months (mean calendar)	2.6283×10^{6}	seconds
myriagrams	10	kilograms
myriameters	10	kilometers
myriawatts	10	kilowatts
nepers	8.686	decibels
newtons	10^{5}	dynes
newtons	0.10197	kilograms
newtons	0.22481	pounds
newtons/sq meter	1.00	pascals (Pa)
noggins (British)	1/32	gallons (British)
No./cu.cm.	28.316×10^{3}	No./cu ft
No./cu.cm.	10^{6}	No./cu meter
No./cu.cm.	1000.0	No./liter
No./cu.ft.	35.314×10^{-6}	No./cu cm
No./cu.ft.	35.314	No./cu meter
No./cu.ft.	35.314×10^{-3}	No./liter

(continued)

(continued)

Multiply	*by*	*to obtain*
No./cu. meter	10^{-6}	No./cu cm
No./cu. meter	28.317×10^{-3}	No./cu ft
No./cu. meter	0.001	No./liter
No./liter	0.001	No./cu cm
No./liter	28.316	No./cu ft
No./liter	1000.0	No./cu meter
oersteds (abs)	1	electromagnetic cgs units of magnetizing force
oersteds (abs)	2.9978×10^{10}	electrostatic cgs units of magnetizing force
ohms	10^{9}	abohms
ohms	1.1126×10^{-12}	statohms
ohms	10^{-6}	megohms
ohms	10^{6}	microhms
ohms (International)	1.0005	ohms (absolute)
ounces (avdp)	16	drams (avoirdupois)
ounces (avdp)	7.2917	drams (troy)
ounces (avdp)	437.5	grains
ounces (avdp)	28.349527	grams
ounces (avdp)	0.028350	kilograms
ounces (avdp)	2.8350×10^{4}	milligrams
ounces (avdp)	0.9114583	ounces (troy)
ounces (avdp)	0.0625	pounds (avoirdupois)
ounces (avdp)	0.075955	pounds (troy)
ounces (avdp)	2.790×10^{-5}	tons (long)
ounces (avdp)	2.835×10^{-5}	tons (metric)
ounces (avdp)	3.125×10^{-5}	tons (short)
ounces (Br. fl)	2.3828×10^{-4}	barrels (U.S.)
ounces (Br. fl)	1.0033×10^{-3}	cubic feet
ounces (Br. fl)	1.73457	cubic inches
ounces (Br. fl)	7.6860	drams (U.S. fl)
ounces (Br. fl)	6.250×10^{-3}	gallons (Br.)
ounces (Br. fl)	0.07506	gallons (U.S.)
ounces (Br. fl)	2.84121×10^{-2}	liters
ounces (Br. fl)	480	minims (Br.)
ounces (Br. fl)	461.160	minims (U.S.)
ounces (Br. fl)	28.4121	mL
ounces (Br. fl)	0.9607	ounces (U.S. fl)
ounces (troy)	17.554	drams (avdp)
ounces (troy)	8	drams (troy)

(continued)

(continued)

Multiply	*by*	*to obtain*
ounces (troy)	480	grains (troy)
ounces (troy)	31.103481	grams
ounces (troy)	0.03110	kilograms
ounces (troy)	1.09714	ounces (avoirdupois)
ounces (troy)	20	pennyweights (troy)
ounces (troy)	0.068571	pounds (avdp)
ounces (troy)	0.08333	pounds (troy)
ounces (troy)	3.061×10^{-5}	tons (long)
ounces (troy)	3.429×10^{-5}	tons (short)
ounces (U.S. fl)	2.48×10^{-4}	barrels (U.S.)
ounces (U.S. fl)	29.5737	cubic centimeters
ounces (U.S. fl)	1.0443×10^{-3}	cubic feet
ounces (U.S. fl)	1.80469	cubic inches
ounces (U.S. fl)	8	drams (fluid)
ounces (U.S. fl)	6.5053×10^{-3}	gallons (Br.)
ounces (U.S. fl)	7.8125×10^{-3}	gallons (U.S.)
ounces (U.S. fl)	29.5729	milliliters
ounces (U.S. fl)	499.61	minims (Br.)
ounces (U.S. fl)	480	minims (U.S.)
ounces (U.S. fl)	1.0409	ounces (Br. fl)
ounces/sq inch	4309	dynes/sq cm
ounces/sq. inch	0.0625	pounds/sq inch
paces	30	inches
palms (British)	3	inches
parsecs	3.260	light years
parsecs	3.084×10^{13}	kilometers
parsecs	3.084×10^{16}	meters
parsec	19×10^{12}	miles
parts/billion (ppb)	10^{-3}	mg/L
parts/million (ppm)	0.07016	grains/imp. gal.
parts/million	0.058417	grains/gallon (U.S.)
parts/million	1.0	mg/liter
parts/million	8.345	lbs/million gallons
ppm by volume (20°C)	$\frac{\text{molecular weight of gas}}{24.04}$	micrograms/liter
ppm by volume (20°C)	$\frac{\text{molecular weight of gas}}{0.02404}$	micrograms/cu meter
ppm by volume (20°C)	$\frac{\text{molecular weight of gas}}{24.04}$	milligrams/cu meter
ppm by volume (20°C)	$\frac{\text{molecular weight of gas}}{28.8}$	ppm by weight

(continued)

(continued)

Multiply	*by*	*to obtain*
ppm by volume (20°C)	$\frac{\text{molecular weight of gas}}{385.1 \times 10^6}$	pounds/cu ft
ppm by weight	1.198×10^{-3}	micrograms/cu meter
ppm by weight	1.198	micrograms/liter
ppm by weight	1.198	milligrams/cu meter
ppm by weight	$\frac{28.8}{\text{molecular weight of gas}}$	ppm by volume (20°C)
ppm by weight	7.48×10^{-6}	pounds/cu ft
pascal (Pa; N/m^2)	1.4504×10^{-4}	pounds/sq ft
pascal (Pa; N/m^2)	2.0885×10^{-2}	pounds/sq ft
pascal (Pa; N/m^2)	2.9613×10^{-4}	in Hg (60°F)
pascal (Pa; N/m^2)	4.0187×10^{-3}	in H_2O (60°F)
pecks (British)	0.25	bushels (British)
pecks (British)	554.6	cubic inches
pecks (British)	9.091901	liters
pecks (U.S.)	0.25	bushels (U.S.)
pecks (U.S.)	537.605	cubic inches
pecks (U.S.)	8.809582	liters
pecks (U.S.)	8	quarts (dry)
pennyweights	24	grains
pennyweights	1.555174	grams
pennyweights	0.05	ounces (troy)
pennyweights (troy)	4.1667×10^{-3}	pounds (troy)
perches (masonry)	24.75	cubic feet
phots	929.0	foot-candles
phots	1	lumen incident/sq cm
phots	10^4	lux
picas (printers')	1/6	inches
pieds (French feet)	0.3249	meters
pints (dry)	33.6003	cubic inches
pints (liq.)	473.179	cubic centimeters
pints (liq.)	0.01671	cubic feet
pints (liq.)	4.732×10^{-4}	cubic meters
pints (liq.)	6.189×10^{-4}	cubic yards
pints (liq.)	0.125	gallons
pints (liq.)	0.4732	liters
pints (liq.)	16	ounces (U.S. fluid)
pints (liq.)	0.5	quarts (liq.)
planck's constant	6.6256×10^{-27}	erg-seconds
poise	1.00	gram/cm sec
poise	0.1	newton-second/$meter^2$

(continued)

(continued)

Multiply	*by*	*to obtain*
population equivalent (PE)	0.17	pounds BOD
pottles (British)	0.5	gallons (British)
pouces (Paris inches)	0.02707	meters
pouces (Paris inches)	0.08333	pieds (Paris feet)
poundals	13,826	dynes
poundals	14.0981	grams
poundals	1.383×10^{-3}	joules/cm
poundals	0.1383	joules/meter (newton)
poundals	0.01410	kilograms
poundals	0.031081	pounds
pounds (avdp)	256	drams (avdp)
pounds (avdp)	116.67	drams (troy)
pounds (avdp)	444,823	dynes
pounds (avdp)	7000	grains
pounds (avdp)	453.5924	grams
pounds (avdp)	0.04448	joules/cm
pounds (avdp)	4.448	joules/meter (newtons)
pounds (avdp)	0.454	kilograms
pounds (avdp)	4.5359×10^{5}	milligrams
pounds (avdp)	16	ounces (avdp)
pounds (avdp)	14.5833	ounces (troy)
pounds (avdp)	32.17	poundals
pounds (avdp)	1.2152778	pounds (troy)
pounds (avdp)	4.464×10^{-4}	tons (long)
pounds (avdp)	0.0005	tons (short)
pounds (troy)	210.65	drams (avdp)
pounds (troy)	96	drams (troy)
pounds (troy)	5760	grains
pounds (troy)	373.2418	grams
pounds (troy)	0.37324	kilograms
pounds (troy)	3.7324×10^{5}	milligrams
pounds (troy)	13.1657	ounces (avdp)
pounds (troy)	12.0	ounces (troy)
pounds (troy)	240.0	pennyweights (troy)
pounds (troy)	0.8229	pounds (avdp)
pounds (troy)	3.6735×10^{-4}	tons (long)
pounds (troy)	3.7324×10^{-4}	tons (metric)
pounds (troy)	4.1143×10^{-4}	tons (short)
pounds (avdp)-force	4.448	newtons
pounds-force-sec/ft^2	47.88026	newton-sec/meter^2
pounds (avdp)-mass	0.4536	kilograms

(continued)

(continued)

Multiply	*by*	*to obtain*
pounds-mass/ft^3	16.0185	kilogram/meter^3
pounds-mass/ft-sec	1.4882	mewton-sec/meter^2
pounds of BOD	5.882	population equivalent (PE)
pounds of carbon to CO_2	14,544	BTU (mean)
pounds of water	0.0160	cu ft
pounds of water	27.68	cu in
pounds of water	0.1198	gallons
pounds of water evaporated at 212°F	970.3	BTU
pounds of water per min	2.699×10^{-4}	cubic feet/sec
pound-feet	13,825	centimeter-grams
pound-feet (torque)	1.3558×10^{7}	dyne-centimeters
pound-feet	0.1383	meter-kilograms
pounds-feet squared	421.3	kg-cm squared
pounds-feet squared	144	pounds-inches squared
pounds-inches squared	2926	kg-cm squared
pounds-inches squared	6.945×10^{-3}	pounds-feet squared
pounds/acre	0.0104	grams/sq ft
pounds/acre	0.1121	grams/sq meter
pounds/acre	1.121	kg/ha
pounds/acre	112.1	kilograms/sq km
pounds/acre	0.01121	milligrams/sq cm
pounds/acre	112.1	milligrams/sq meter
pounds/acre	0.023	pounds/1000 sq ft
pounds/acre	0.32	tons/sq mile
pounds/acre/day	0.112	g/day/sq m
pounds/cu ft	0.0160	g/mL
pounds/cu ft	16.02	kg/cu m
pounds/cu ft	16.018×10^{9}	micrograms/cu meter
pounds/cu ft	16.018×10^{6}	micrograms/liter
pounds/cu ft	16.018×10^{6}	milligrams/cu meter
pounds/cu ft	$\frac{385.1 \times 10^{6}}{\text{molecular weight of gas}}$	ppm by volume (20°C)
pounds/cu ft	133.7×10^{3}	ppm by weight
pounds/cu ft	5.787×10^{-4}	lb/cu in
pounds/cu ft	5.456×10^{-9}	pounds/mil-foot
pounds/1000 cu ft	0.35314	grams/cu ft
pounds/1000 cu ft	16.018	grams/cu m
pounds/1000 cu ft	353.14×10^{3}	micrograms/cu ft
pounds/1000 cu ft	16.018×10^{6}	microgram/cu m

(continued)

(continued)

Multiply	*by*	*to obtain*
pounds/1000 cu ft	16.018×10^3	milligrams/cu m
pounds/cubic inch	27.68	grams/cubic cm
pounds/cubic inch	2.768×10^4	kgs/cubic meter
pounds/cubic inch	1728	pounds/cubic foot
pounds/cubic inch	9.425×10^{-6}	pounds/mil foot
pounds/day/acre-ft	3.68	g/day/cu m
pounds/day/cu ft	16	kg/day/cu m
pounds/day/cu yd	0.6	kg/day/cu m
pounds/day/sq ft	4,880	g/day/sq m
pounds/ft	1.488	kg/m
pounds/gal	119.947	g/liter
pounds/1000-gal	120	g/1000-liters
pounds/horsepower-hour	0.169	mg/joule
pounds/in	178.6	g/cm
pounds/mil-foot	2.306×10^6	gms/cu cm
pounds/mil gal	0.12	g/cu m
pounds/sq ft	4.725×10^{-4}	atmospheres
pounds/sq ft	0.01602	ft of water
pounds/sq ft	0.01414	inches of mercury
pounds/sq ft	4.8824×10^{-4}	kgs/sq cm
pounds/sq ft	4.88241	kilograms/square meter
pounds/sq ft	47.9	newtons/sq m
pounds/sq ft	6.944×10^{-3}	pounds/sq inch
pounds/1000 sq ft	0.4536	grams/sq ft
pounds/1000 sq ft	4.882	grams/sq meter
pounds/1000 sq ft	4882.4	kilograms/sq km
pounds/1000 sq ft	0.4882	milligrams/sq cm
pounds/1000 sq ft	4882.4	kilograms/sq meter
pounds/1000 sq ft	43.56	milligrams/sq cm
pounds/1000 sq ft	13.94	milligrams/sq meter
pounds/sq in	0.068046	atmospheres
pounds/sq in	2.307	ft of water
pounds/sq in	70.307	grams/square centimeter
pounds/sq in	2.036	in of mercury
pounds/sq in	0.0703	kgs/square cm
pounds/sq in	703.07	kilograms/square meter
pounds/sq in	51.715	millimeters of mercury
pounds/sq in	6894.76	newton/meter^2
pounds/sq in	51.715	millimeters of mercury at 0°C
pounds/sq in	144	pounds/sq foot

(continued)

(continued)

Multiply	*by*	*to obtain*
pounds/sq in (abs)	1	pound/sq in (gage) + 14.696
pounds/ton	0.5	kg/metric ton; kg/T
proof(U.S.)	0.5	percent alcohol by volume
puncheons (British)	70	gallons (British)
quadrants (angle)	90	degrees
quadrants (angle)	5400	minutes
quadrants (angle)	3.24×10^5	seconds
quadrants (angle)	1.571	radians
quarts (dry)	67.20	cubic inches
quarts (liq.)	946.4	cubic centimeters
quarts (liq.)	0.033420	cubic feet
quarts (liq.)	57.75	cubic inches
quarts (liq.)	9.464×10^{-4}	cubic meters
quarts (liq.)	1.238×10^{-3}	cubic yards
quarts (liq.)	0.25	gallons
quarts (liq.)	0.9463	liters
quarts (liq.)	32	ounces (U.S., fl)
quarts (liq.)	0.832674	quarts (British)
quintals (long)	112	pounds
quintals (metric)	100	kilograms
quintals (short)	100	pounds
quires	24	sheets
radians	57.29578	degrees
radians	3438	minutes
radians	0.637	quadrants
radians	2.063×10^5	seconds
radians/second	57.30	degrees/second
radians/second	9.549	revolutions/min
radians/second	0.1592	revolutions/sec
radians/sec/sec	573.0	revs/min/min
radians/sec/sec	9.549	revs/min/sec
radians/sec/sec	0.1592	revs/sec/sec
reams	500	sheets
register tons (British)	100	cubic feet
revolutions	360	degrees
revolutions	4	quadrants
revolutions	6.283	radians
revolutions/minute	6	degrees/second
revolutions/minute	0.10472	radians/second
revolutions/minute	0.01667	revolutions/sec

(continued)

(continued)

Multiply	*by*	*to obtain*
revolutions/minute^2	0.0017453	radians/sec/sec
revs/min/min	0.01667	revs/min/sec
revs/min/min	2.778×10^{-4}	revs/sec/sec
revolutions/second	360	degrees/second
revolutions/second	6.283	radians/second
revolutions/second	60	revs/minute
revs/sec/sec	6.283	rads/sec/sec
revs/sec/sec	3600	revs/min/min
revs/sec/sec	60	revs/min/sec
reyns	6.8948×10^6	centipoises
rod	.25	chain (gunters)
rods	16.5	feet
rods	5.0292	meters
rods	3.125×10^{-3}	miles
rods (surveyors' means)	5.5	yards
roods (British)	0.25	acres
scruples	1/3	drams (troy)
scruples	20	grains
sections	1	square miles
seconds (mean solar)	1.1574×10^{-5}	days
seconds (angle)	2.778×10^{-4}	degrees
seconds (mean solar)	2.7778×10^{-4}	hours
seconds (angle)	0.01667	minutes
seconds (angle)	3.087×10^{-6}	quadrants
seconds (angle)	4.848×10^{-6}	radians
slugs	14.59	kilogram
slugs	32.174	pounds
space, entire (solid angle)	12.566	steradians
spans	9	inches
spheres (solid angle)	12.57	steradians
spherical right angles	0.25	hemispheres
spherical right angles	0.125	spheres
spherical right angles	1.571	steradians
square centimeters	1.973×10^5	circular mils
square centimeters	1.07639×10^{-3}	square feet (U.S.)
square centimeters	0.15499969	square inches (U.S.)
square centimeters	10^{-4}	square meters
square centimeters	3.861×10^{-11}	square miles
square centimeters	100	square millimeters
square centimeters	1.196×10^{-4}	square yards

(continued)

(continued)

Multiply	*by*	*to obtain*
square centimeters-square centimeter (moment of area)	0.024025	square inch-square inch
square chains (gunter's)	0.1	acres
square chains (gunter's)	404.7	square meters
square chains (Ramden's)	0.22956	acres
square chains (Ramden's)	10000	square feet
square feet	2.29×10^{-5}	acres
square feet	1.833×10^{8}	circular mils
square feet	144	square inches
square feet	0.092903	square meters
square feet	929.0341	square centimeters
square feet	3.587×10^{-8}	square miles
square feet	1/9	square yards
square feet/cu ft	3.29	sq m/cu m
square foot-square foot (moment of area)	20,736	square inch-square inch
square inches	1.273×10^{6}	circular mils
square inches	6.4516258	square centimeters
square inches	6.944×10^{-3}	square feet
square inches	645.2	square millimeters
square inches	10^{6}	square mils
square inches	7.71605×10^{-4}	square yards
square inches-inches sqd.	41.62	sq cm-cm sqd
square inches-inches sqd.	4.823×10^{-5}	sq feet-feet sqd
square kilometers	247.1	acres
square kilometers	10^{10}	square centimeters
square kilometers	10.76×10^{6}	square feet
square kilometers	1.550×10^{9}	square inches
square kilometers	10^{6}	square meters
square kilometers	0.3861006	square miles (U.S.)
square kilometers	1.196×10^{6}	square yards
square links (Gunter's)	10^{-5}	acres (U.S.)
square links (Gunter's)	0.04047	square meters
square meters	2.471×10^{-4}	acres (U.S.)
square meters	10^{4}	square centimeters
square meters	10.76387	square feet (U.S.)
square meters	1550	square inches
square meters	3.8610×10^{-7}	square miles (statute)
square meters	10^{6}	square millimeters
square meters	1.196	square yards (U.S.)

(continued)

(continued)

Multiply	*by*	*to obtain*
square miles	640	acres
square miles	2.78784×10^{7}	square feet
square miles	2.590	sq km
square miles	2.5900×10^{6}	square meters
square miles	3.098×10^{6}	square yards
square millimeters	1.973×10^{3}	circular mils
square millimeters	0.01	square centimeters
square millimeters	1.076×10^{-5}	square feet
square millimeters	1.550×10^{-3}	square inches
square mils	1.273	circular mils
square mils	6.452×10^{-6}	square centimeters
square mils	10^{-6}	square inches
square rods	272.3	square feet
square yard	2.1×10^{-4}	acres
square yards	8361	square centimeters
square yards	9	square feet
square yards	1296	square inches
square yards	0.8361	square meters
square yards	3.228×10^{-7}	square miles
square yards	8.361×10^{5}	square millimeters
statamperes	3.33560×10^{-10}	amperes (abs)
statcoulombs	3.33560×10^{-10}	coulombs (abs)
statcoulombs/kilogram	1.0197×10^{-6}	statcoulombs/dyne
statfarads	1.11263×10^{-12}	farads (abs)
stathenries	8.98776×10^{11}	henries (abs)
statohms	8.98776×10^{11}	ohms (abs)
statvolts	299.796	volts (abs)
statvolts/inch	118.05	volts (abs)/centimeter
statwebers	2.99796×10^{10}	electromagnetic cgs units of magnetic flux
statwebers	1	electrostatic cgs units of magnetic flux
stilb	2919	footlambert
stilb	1	int. candle cm^{-2}
stilb	3.142	lambert
stoke (kinematic viscosity)	10^{-4}	$meter^2$/second
stones (British)	6.350	kilograms
stones (British)	14	pounds
temp. (degs. C.) + 273	1	abs. temp. (degs. K.)
temps (degs. C.) + 17.8	1.8	temp. (degs. Fahr.)

(continued)

(continued)

Multiply	*by*	*to obtain*
temps. (degs. F.) + 460	1	abs. temp. (degs. R.)
temps. (degs. F.) − 32	5/9	temp. (degs. Cent.)
toises (French)	6	paris feet (pieds)
tons (long)	5.734×10^5	drams (avdp)
tons (long)	2.613×10^5	drams (troy)
tons (long)	1.568×10^7	grains
tons (long)	1.016×10^6	grams
tons (long)	1016	kilograms
tons (long)	3.584×10^4	ounces (avdp)
tons (long)	3.267×10^4	ounces (troy)
tons (long)	2240	pounds (avdp)
tons (long)	2722.2	pounds (troy)
tons (long)	1.12	tons (short)
Tons (metric) (T)	1000	kilograms
Tons (metric) (T)	2204.6	pounds
Tons (metric) (T)	1.1025	tons (short)
tons (short)	5.120×10^5	drams (avdp)
tons (short)	2.334×10^5	drams (troy)
tons (short)	1.4×10^7	grains
tons (short)	9.072×10^5	grams
tons (short)	907.2	kilograms
tons (short)	32,000	ounces (avdp)
tons (short)	29,166.66	ounces (troy)
tons (short)	2000	pounds (avdp)
tons (short)	2.430.56	pounds (troy)
tons (short)	0.89287	tons (long)
tons (short)	0.9078	Tons (metric) (T)
tons (short)/acre	2.2422	metric ton/ha
tons (short)/sq ft	9765	kg/sq meter
tons (short)/sq ft	13.89	pounds/sq inch
tons (short)/sq in	1.406×10^6	kg/sq meter
tons/sq mile	3.125	pounds/acre
tons/sq mile	0.07174	pounds/1000 sq ft
tons/sq mile	0.3503	grams/sq meter
tons/sq mile	350.3	kilograms/sq km
tons/sq mile	350.3	milligrams/sq meter
tons/sq mile	0.03503	milligrams/sq cm
tons/sq mile	0.03254	grams/sq ft
tons of water/24 hours	83.333	pounds of water/hr
tons of water/24 hours	0.16643	gallons/min

(continued)

(continued)

Multiply	*by*	*to obtain*
tons of water/24 hours	1.3349	cu ft/hr
torr (mm Hg, 0 C)	133.322	newton/meter^2
townships (U.S.)	23040	acres
townships (U.S.)	36	square miles
tuns	252	gallons
volts (abs)	10^8	abvolts
volts (abs)	3.336×10^{-3}	statvolts
volts (international of 1948)	1.00033	volts (abs)
volt/inch	.39370	volt/cm
watts (abs)	3.41304	BTU (mean)/hour
watts (abs)	0.0569	BTU (mean)/min
watts (abs)	0.01433	calories, kilogram (mean)/ minute
watts (abs)	10^7	ergs/second
watts (abs)	44.26	foot-pounds/minute
watts (abs)	0.7376	foot-pounds/second
watts (abs)	0.0013405	horsepower (electrical)
watts (abs)	1.360×10^{-3}	horsepower (metric)
watts (abs)	1	joules/sec
watts (abs)	0.10197	kilogram-meters/second
watts (abs)	10^{-3}	kilowatts
watt-hours	3.415	British Thermal Units
watt-hours	3.60×10^{10}	ergs
watt-hours	2655	foot-pounds
watt-hours	859.85	gram-calories
watt-hours	1.34×10^{-3}	horsepower-hours
watt-hours	3.6×10^3	joule
watt-hours	0.8605	kilogram-calories
watt-hours	367.1	kilogram-meters
watt-hours	10^{-3}	kilowatt-hours
watt (international)	1.0002	watt (absolute)
watt/(cm^2)(°C/cm)	693.6	BTU/(hr)(ft^2)(°F/in)
wave length of the red line of cadmium	6.43847×10^{-7}	meters
webers	10^3	electromagnetic cgs units
webers	3.336×10^{-3}	electrostatic cgs units
webers	10^5	kilolines
webers	10^8	lines
webers	10^8	maxwells
webers	3.336×10^{-3}	statwebers

(continued)

(continued)

Multiply	*by*	*to obtain*
webers/sq in	1.550×10^7	gausses
webers/sq in	10^8	lines/sq in
webers/sq in	0.1550	webers/sq cm
webers/sq in	1,550	webers/sq meter
webers/sq meter	10^4	gausses
webers/sq meter	6.452×10^4	lines/sq in
webers/sq meter	10^{-4}	webers/sq cm
webers/sq meter	6.452×10^{-4}	webers/sq in
weeks	168	hours
weeks	10,080	minutes
weeks	604,800	seconds
yards	91.44	centimeters
yards	3	feet
yards	36	inches
yards	9.144×10^{-4}	kilometers
yards	0.91440	meters
yards	4.934×10^{-4}	miles (naut.)
yards	5.682×10^{-4}	miles (stat.)
yards	914.4	millimeters
years (sidereal)	365.2564	days (mean solar)
years (sidereal)	366.2564	days (sidereal)
years (tropical, mean solar)	365.2422	days (mean solar)
years (common)	8760	hours
years (tropical, mean solar)	8765.8128	hours (mean solar)
years (leap)	366	days
years (leap)	8784	hours
years (tropical, mean solar)	3.155693×10^7	seconds (mean solar)
years (tropical, mean solar)	1.00273780	years (sidereal)

2. BASIC AND SUPPLEMENTARY UNITS

A *meter (m)* is 1,650,763.73 wavelengths in vacuo of the radiation corresponding to the transition between the energy levels $2p_{10}$ and $5d_5$ of the krypton 86 atom.

A *kilogram (kg)* is the mass of the international prototype in the custody of the Bureau International des Poids et Mesures at Sevres in France.

A *second (sec)* is the interval occupied by 9,192,631,770 cycles of the radiation corresponding to the transition of the cesium-133 atom when unperturbed by exterior fields.

An *ampere* is the constant current that if maintained in two parallel rectilinear conductors of infinite length of negligible circular cross section and placed at a distance of one meter apart in vacuo would produce between these conductors a force equal to 2×10^{-7} newton per meter length.

A *kelvin* (°K) is the degree interval of the thermodynamic scale on which the temperature of the triple point of water is 273.16 degrees.

A *candle* is such that the luminance of a full radiator at the temperature of solidification of platinum is 60 units of luminous intensity per square centimeter.

A *mole (mol)* is the amount of substance which contains as many elementary units as there are atoms in 0.012 kg of carbon-12. The elementary unit must be specified and may be an atom, an ion, an electron, a photon, etc., or a given group of such entities.

A *radian* is the angle subtended at the center of a circle by an arc of the circle equal in length to the radius of the circle.

A *steradian* is the solid angle that, having its vertex at the center of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere.

3. DERIVED UNITS AND QUANTITIES

The *liter* was defined in 1901 as the volume of 1 kilogram of pure water at normal atmospheric pressure and maximum density equal therefore to 1.000028 dm^3. This 1901 definition applied for the purpose of the 1963 Weights and Measures Acts.

By a resolution of the 12th Conference General des Poids et Mesures (CGPM) in 1964 the word *liter* is now recognized as a special name for the dm^3, but is not used to express high precision measurements. It is used widely in engineering and the retail business, where the discrepancy of 28 parts in 1 million is of negligible significance.

A *newton (N)* is the force that, when applied to a body of mass of one kilogram, gives it an acceleration of one meter per second per second.
Stress is defined as the resultant internal force per unit area resisting change in the shape or size of a body acted on by external forces, and is therefore measured in *newtons per square meter* (N/m^2).

A *bar* is a pressure equivalent to 100,000 newtons acting on an area of one square metor.

A *joule (J)* is the work done when the point of application of a force of one newton is displaced through a distance of one meter in the direction of the force.

A *watt* is equal to one joule per second.

Dynamic viscosity is the property of a fluid whereby it tends to resist relative motion within itself. It is the shear stress, i.e., the tangential force on unit area, between two infinite horizontal planes at unit distance apart, one of which is fixed while the other moves with unit velocity. In other words, it is the shear stress divided by the velocity gradient, i.e., $(N/m^2) \div (m/sec/m) = N\ sec/m^2$.

Kinematic viscosity is the dynamic viscosity of a fluid divided by its density, i.e., $(N\ sec/m^2)/(kg/m^3) = m^2/sec$.

Density of heat flow rate (or heat flux) is the heat flow rate (W) per unit area, i.e., W/m^2.

Coefficient of heat transfer is the heat flow rate (W) per unit area per unit temperature difference, i.e., $W/m^{2\circ}$ C.

Thermal conductivity is the quantity of heat that will be conducted in unit time through unit area of a slab of material of unit thickness with a unit difference of temperature between the faces; in other words, the heat flow rate (W) per unit area per unit temperature gradient, i.e., $W/[m^2(^\circ C/m)] = W/m^\circ$ C.

The *heat capacity* of a substance is the quantity of heat gained or lost by the substance per unit temperature change, i.e., J/° C.

Specific heat capacity is the heat capacity per unit mass of the substance, i.e., J/kg° C.

Internal energy is the kinetic energy possessed by the molecules of a substance due to temperature and is measured in joules (J).

Specific internal energy (u) is the internal energy per unit mass of the substance, i.e., J/kg. When a small amount of heat is added at constant volume the increase in specific internal energy is given by: $du = c_v\, dT$, where c_v is the specific heat capacity at constant volume, and dT is the increase in absolute temperature.

Specific enthalpy (h) is defined by the equation: $h = u + pv$, where p is the pressure and v is the specific volume. Specific enthalpy is measured in J/kg. When a small amount of heat is added to a substance at constant pressure, the increase in specific enthalpy is given by: $-dh = cp\, dT$, where cp is the specific heat capacity at constant pressure.

The *specific latent heat* of a substance is the heat gained per unit mass without an accompanying rise in temperature during a change of state at constant pressure. It is measured in J/kg.

The *entropy* (S) of a substance is such that when a small amount of heat is added, the increase in entropy is equal to the quantity of heat added (dQ) divided by the absolute temperature (T) at which the heat is absorbed; i.e., $dS = dQ/T$, measured in J/°K.

The *specific entropy* (s) of a substance is the entropy per unit mass, i.e., J/kg°K.

A *volt* is the difference of electric potential between two points of a conductor carrying a constant current of one ampere when the power dissipated is one watt.

A *weber* (Wb) is the magnetic flux through a conductor with a resistance of one ohm when reversal of the direction of the magnetic flux causes the transfer of one coulomb in the conductor loop.

Tesla: The magnetic flux density is the normal magnetic flux per unit area and is measured in *teslas*.

A *lumen*, the unit of luminous flux, is the flux emitted within unit solid angle of one steradian by a point source having a uniform intensity of one candle.

A *lux* is an illumination of one lumen per square meter.

Luminance is the luminous intensity per unit area of a source of light or of an illumination. It is measured in candles per square meter.

4. PHYSICAL CONSTANTS

Standard temperature and pressure (S.T.P.)	$\begin{cases} = 273.15°K \text{ and } 1.013 \times 10^5 N/m^2 \\ = 0°C \text{ and } 1.013 \text{ bar} \\ = 0°C \text{ and } 760 \text{ mmHg} \end{cases}$
Molecular volume of ideal gas at S.T.P.	= 22.4 litres/mol
Gas constant (R)	= 8.314 J/mol° K
$^{RT}(273.15°K)$	$= 2.271 \times 10^3$ J/mol
Avogadro constant	$= 6.023 \times 10^{23}$/mol
Boltzmann constant	$= 1.3805 \times 10^{-23}$ J/K
Faraday constant	$= 9.6487 \times 10^{4\circ C}$/mol (= A s/mol)
Planck constant	$= 6.626 \times 10^{-34}$ J sec
Stefan-Boltzman constant	$= 5.6697 \times 10^{-8}$ W/m^2 K^4
Ice point of water	= 273.15°K (0°C)
Triple point of water	= 273.16°K (0.01°C)
Speed of light	$= 2.998 \times 10^8$ m/sec
Acceleration of gravity (Standard) (Greenwich)	$\begin{cases} = 9.80665 \text{ m/s}^2 \left[\begin{matrix}\text{take g as} \\ 9.81 \text{ m/s}^2\end{matrix}\right] \\ = 9.81188 \text{ m/s}^2 \end{cases}$
Universal constant of gravitation	$= 6.670 \times 10^{-11}$ Newton m^2/kg^2
Mass of hydrogen atom	$= 1.6734 \times 10^{-27}$ kg

5. PROPERTIES OF WATER

U.S. Customary Units

Temperature (°F)	Specific weight, γ (lb/ft^3)	Mass density, ρ (lb-sec^2/ft^4)	Dynamic viscosity, $\mu \times 10^5$ (lb-sec/ft^2)	Kinematic viscosity, $\nu \times 10^5$ (ft^2/sec)	Surface tension[a], $\sigma \times 10^3$ (lb/ft)	Vapor pressure, p_ν(lb/in.^{2})	Bulk modulus[b], $E \times 10^{-3}$ (lb/in.^{2})
32	62.42	1.940	3.746	1.931	5.18	0.09	290
40	62.43	1.938	3.229	1.664	5.14	0.12	295
50	62.41	1.936	2.735	1.410	5.09	0.18	300
60	62.37	1.934	2.359	1.217	5.04	0.26	312
70	62.30	1.931	2.050	1.059	5.00	0.36	320
80	62.22	1.927	1.799	0.930	4.92	0.51	323
90	62.11	1.923	1.595	0.826	4.86	0.70	326
100	62.00	1.918	1.424	0.739	4.80	0.95	329
110	61.86	1.913	1.284	0.667	4.73	1.24	331
120	61.71	1.908	1.168	0.609	4.65	1.69	333
130	61.55	1.902	1.069	0.558	4.60	2.22	332

(continued)

U.S. Customary Units (continued)

Temperature (°F)	Specific weight, γ (lb/ft^3)	Mass density, ρ (lb-sec^2/ft^4)	Dynamic viscosity, $\mu \times 10^5$ (lb-sec/ft^2)	Kinematic viscosity, $\nu \times 10^5$ (ft^2/sec)	Surface tension[a], $\sigma \times 10^3$ (lb/ft)	Vapor pressure, p_ν(lb/in.^{2})	Bulk modulus[b], $E \times 10^{-3}$ (lb/in.^{2})
140	61.38	1.896	0.981	0.514	4.54	2.89	330
150	61.20	1.890	0.905	0.476	4.47	3.72	328
160	61.00	1.896	0.838	0.442	4.41	4.74	326
170	60.80	1.890	0.780	0.413	4.33	5.99	322
180	60.58	1.883	0.726	0.385	4.26	7.51	318
190	60.36	1.876	0.678	0.362	4.19	9.34	313
200	60.12	1.868	0.637	0.341	4.12	11.52	308
212	59.83	1.860	0.593	0.319	4.04	14.7	300

[a]In contact with air ; [b]At atmospheric pressure.

SI Units

Temperatue, (°C)	Specific weight, γ (kN/m^3)	Mass density, ρ (kg/m^3)	Dynamic viscosity, $\mu \times 10^3$ (N · s/m^2)	Kinematic viscosity, $\nu \times 10^6$ (m^2/s)	Surface tension[a], σ (N/m)	Vapor pressure,p_ν (kN/m^2)	Bulk modulus[b], $E \times 10^{-6}$ (kN/m^2)
0	9.805	999.8	1.781	1.785	0.0765	0.61	1.98
5	9.807	1000.0	1.518	1.519	0.0749	0.87	2.05
10	9.804	999.7	1.307	1.306	0.0742	1.23	2.10
15	9.798	999.1	1.139	1.139	0.0735	1.70	2.15
20	9.789	998.2	1.002	1.003	0.0728	2.34	2.17
25	9.777	997.0	0.890	0.893	0.0720	3.17	2.22
30	9.764	995.7	0.798	0.800	0.0712	4.24	2.25
40	9.730	992.2	0.653	0.658	0.0696	7.38	2.28
50	9.689	988.0	0.547	0.553	0.0679	12.33	2.29
60	9.642	983.2	0.466	0.474	0.0662	19.92	2.28
70	9.589	977.8	0.404	0.413	0.0644	31.16	2.25
80	9.530	971.8	0.354	0.364	0.0626	47.34	2.20
90	9.466	965.3	0.315	0.326	0.0608	70.10	2.14
100	9.399	958.4	0.282	0.294	0.0589	101.33	2.07

[a]In contact with air; [b] At atmospheric pressure.

6. PERIODIC TABLE OF THE ELEMENTS (COMPLIMENTS OF THE LENOX INSTITUTE OF WATER TECHNOLOGY)

Groups ⇨ / Periods & sub-shells ⇩	I IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 IIIA	14 VIA	15 VA	16 VIA	17 VIIA	18 O
I IS	1 H 1.00794 Hydrogen																I H 1.00794 Hydrogen	2 He 4.00260 Helium
2 2s2p	3 Li 6.941 Lithium	4 Be 9.01218 Beryllium											5 B 10.811 Boron	6 C 12.011 Boron	7 N 14.0067 Nitrogen	8 O 15.9994 Oxygen	9 F 18.9984 Fluorine	10 Ne 20.179 Neon
3 3s3p	11 Na 22.9897 Sodium	12 Mg 24.305 Magnesium											13 Al 26.9815 Aluminum	14 Si 28.0855 Silicon	15 P 30.9738 Phosphorus	16 S 32.066 Sulfur	17 CI 35.4527 Chlorine	18 Ar 39.948 Argon
4 4s3d4p	19 K 39.098 Potassium	20 Ca 40.078 Calcium	21 Sc 44.9559 Scandium	22 Ti 47.88 Titanium	23 V 50.9415 Vanadium	24 Cr 51.996 Chromium	25 Mn 54.938 Manganese	26 Fe 55.847 Iron	27 Co 58.933 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.546 Copper	30 Zn 65.39 Zinc	31 Ga 69,723 Gallium	32 Ge 69.561 Germanium	33 As 74.9216 Arsenic	34 Se 78.96 Selenium	35 Br 79.904 Bromine	36 Kr 83.80 Krypton
5 5s4d5p	37 Rb 85.468 Rubidium	38 Sr 87.62 Strontium	39 Y 88.9059 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.9064 Niobium	42 Mo 95.94 Molybdenum	43 Tc (98) Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.906 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.868 Silver	48 Cd 112.411 Cadmium	49 In 114.82 Indium	50 Sn 118.710 Tin	51 Sb 121.75 Antimony	52 Te 127.60 Tellurium	53 I 126.90 Iodine	54 Xe 131.29 Xenon
6 6s4f5d6p	55 Cs 132.905 Cesium	56 Ba 137.327 Barium	57 La 138.906 Lanthanum	72 Hf 178.49 Hafnium	73 Ta 180.948 Tantalum	74 W 183.85 Tungsten	75 Re 186.207 Rhenium	76 Os 190.2 Osmium	77 Ir 192.22 Iridium	78 Pt 195.08 Platinum	79 Au 196.97 Gold	80 Hg 200.59 Mercury	81 Tl 204.383 Thallium	82 Pb 207.2 Lead	83 Bi 208.98 Bismuth	84 Po (209) Polonium	85 At (210) Astatine	86 Rn (222) Radon
7 7s5f6d	87 Fr (223) Francium	88 Ra (226) Radium	89 Ac (227) Actinium	104 Rf (261) Ruther-fordium	105 Ha (262) Dubnium	106 Sg (263) Seaborgium	107 Ns (262) Bohrium	108 Hs (265) Hassium	109 Mt (266) Meitnerium	110		112						

6 4f	58 Ce 140.116 Cerium	59 Pr 140.91 Praseody-mium	60 Nd 144.24 Neodymium	61 Pm (145) Promethium	62 Sm 150.35 Samarium	63 Eu 107.26 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.925 Terbium	66 Dy 162.50 Dysprosium	67 Ho 104.930 Holmium	68 Er 167.26 Erbium	69 Tm 168.934 Thulium	70 Yb 173.04 Ytterbium	71 Lu 174.967 Lutetium
7 5f	90 Th 232.038 Thorium	91 Pa (231) Protactinium	92 U 238.029 Uranium	93 Np (237) Neptunium	94 Pu (244) Plutonium	95 Am (243) Americium	96 Cm (247) Curium	97 Bk (247) Berkelium	98 Cf (251) Californium	99 Es (252) Einsteinium	100 Fm (257) Fermium	101 Md (258) Mendelevium	102 No (259) Nobelium	103 Lr (262) Lawrencium

7. GLOSSARY FOR WATER RESOURCES ENGINEERS

Ablation The process by which ice and snow waste away, owing to melting and evaporation.

Absorption The entrance of water into the soil or rocks by all natural processes. It includes the infiltration of precipitation or snowmelt, gravity flow of streams into the valley alluvium (see Bank storage) into sinkholes or other large openings, and the movement of atmospheric moisture.

Acequia Acequias are gravity-driven waterways, similar in concept to a flume. Most are simple ditches with dirt banks, but they can be lined with concrete. They were important forms of irrigation in the development of agriculture in the American Southwest. The proliferation of cotton, pecans, and green chile as major agricultural staples owes their progress to the acequia system.

Acid A substance that has a pH of less than 7, which is neutral. Specifically, an acid has more free hydrogen ions (H^+) than hydroxyl ions (OH^-).

Acid neutralizing capacity (ANC) The equivalent capacity of a solution to neutralize strong acids.

Acid rain or acid precipitation Precipitation having a pH lower than the pH range commonly found in natural waters, caused by absorption from the atmosphere of sulfur dioxide gas and nitrogen oxides gas, which then forms sulfuric acid and nitric acid, respectively, in solution.

Action level The level of toxic substances (such as lead or copper) which, if exceeded, triggers treatment or other requirements that a water system must follow.

Acute health effect An immediate (i.e., within hours or days) effect that may result from exposure to certain drinking water contaminants (e.g., pathogens).

Advisory A nonregulatory document that communicates risk information to those who may have to make risk management decisions. For example, a fish consumption advisory may recommend that people limit or avoid eating certain species of fish caught from certain lakes, rivers, or coastal waters. In some cases, advisories may include recommendations for specific groups (such as infants, children, the elderly, or women who are pregnant or may become pregnant).

Agricultural and animal waste Waste generated by the production and harvest of crops or trees or the rearing of animals. Animal waste is a subset of agricultural waste and includes waste (e.g., feed waste, bedding and litter, and feedlot and paddock runoff) from livestock, dairy, and other animal-related agricultural and farming practices.

Agricultural land Land on which a food, feed, or fiber crop is grown. This includes rangeland or land used as pasture.

Agronomic rate The whole sludge application rate designed to (1) provide the amount of nitrogen needed by a crop or vegetation grown on the land and (2) minimize the amount of nitrogen in the sewage sludge that passes below the root zone of the crop or vegetation grown on the land to the groundwater.

Air pollutant Any substance in air that could, in high enough concentration, harm humans, animals, vegetation, or material. Air pollutants can include almost any natural or artificial composition of matter capable of being airborne—solid particles, liquid droplets, gases, or a combination thereof. Air pollutants are often grouped in categories for ease in classification; some of the categories are sulfur compounds, volatile organic compounds, particulate matter, nitrogen compounds, and radioactive compounds.

Air quality index (AQI) An index for reporting daily air quality that characterizes air pollution levels and associated health effects that might be of concern. The US EPA calculates the AQI for five criteria pollutants. AQI values range from 0 to 500; the higher the AQI value, the greater the level of air pollution and the greater the health concern. AQI values below 100 are generally thought of as

satisfactory. When AQI values are above 100, air quality is considered to be unhealthy—at first for certain sensitive groups of people, then for everyone as AQI values get higher.

Air quality system (AQS) US EPA's electronic repository of ambient air monitoring data collected by US EPA and state, local, and tribal air pollution control agencies from thousands of monitoring stations. The AQS contains monitoring data, descriptive information about monitoring stations, and data quality assurance and quality control information.

Air toxics Air pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. Examples of toxic air pollutants include benzene (found in gasoline), perchloroethylene (emitted from some dry cleaning facilities), and methylene chloride (used as a solvent by a number of industries). Air toxics are also known as hazardous air pollutants.

Algal bloom A sudden, excessive growth of algae in a waterbody.

Alkaline Sometimes water or soils contain an amount of alkali (strongly basic) substances sufficient to raise the pH value above 7.0 and be harmful to the growth of crops.

Alkalinity The capacity of water for neutralizing an acid solution.

Alluvium Deposits of clay, silt, sand, gravel, or other particulate material that have been deposited by a stream or other bodies of running water in a streambed, on a flood plain, on a delta, or at the base of a mountain.

Ambient monitoring Monitoring within natural systems (e.g., lakes, rivers, estuaries, wetlands) to determine existing conditions.

Anabranch A diverging branch of a river which reenters the mainstream.

Anaerobic Without oxygen; water and sediment environments without oxygen produce, for example, chemical conditions that precipitate and permanently store many metals from water and that release dissolved phosphorus to the water.

Anchor ice Ice in the bed of a stream or upon a submerged body or structure.

Annual flood The highest peak discharge in a water year.

Annual flood series A list of annual floods.

Annual pollutant loading rate (APLR) The maximum amount of a pollutant that can be applied to a unit area of land during a 365-day period. This term describes pollutant limits for sewage sludge that is given away or sold in a bag or other container for application to the land.

Annual whole sludge application rate The maximum amount of sewage sludge on a dry weight basis that can be applied to a land application site during a 365-day (1-year) period.

Antecedent precipitation index An index of moisture stored within a drainage basin before a storm.

Anthropogenic Originating from humans; not naturally occurring.

Appropriation doctrine The system for allocating water to private individuals used in most Western states. The doctrine of prior appropriation was in common use throughout the arid West as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of "First in Time, First in Right." The first person to take a quantity of water and put it to beneficial use has a higher priority of right than a subsequent user. Under drought conditions, higher-priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrasts with riparian water rights.

Aquaculture (1) Farming of plants and animals that live in water, such as fish, shellfish, and algae; (2) a process for removing pollutants from water through the use of aquatic plants (such as water hyacinths) in pond contaminants. The contaminants are either synthesized by, or bioaccumulated in, the aquatic plants, which ultimately are harvested for disposal.

Aquaculture, living machine system A man-made wastewater-treatment system which adapts and enhances the ecological processes in a series of tidal wetland cells or basins. Each cell or basin is filled with special gravel that promotes the development of micro-ecosystems. A computer controls fill and drain cycles, alternating anoxic (without oxygen) and aerobic (with oxygen) conditions. As wastewater moves through the system, the cells are alternately flooded and drained to create multiple tidal cycles each day, much like one finds in nature, resulting in high-quality reusable water.

Aquaculture, natural and constructed wetland systems The aquatic wastewater-treatment systems involve in the production of algae and higher plants (both submerged and emergent), invertebrates, and fish for wastewater treatment and water conservation. Wastewater treatment by natural and constructed wetland systems is generally accomplished by sprinkling or flood irrigating the wastewater into the wetland area or by passing the wastewater through a system of shallow ponds, channels, basins, or other constructed areas where the emergent aquatic vegetation has been planted or naturally occurs and is actively growing. The treated wastewater is totally reused in a natural environment, achieving almost 100 % water conservation. The vegetation produced as a result of the system's operation may or may not be removed and can be utilized for various purposes: (a) composted for use as source of fertilizer/soil conditioner and (b) dried or otherwise processed for use as animal feed supplements, or digested to produce methane.

Aquaculture, water hyacinth system Wastewater treatment by aquaculture water hyacinth system is accomplished by passing the wastewater through a hyacinth-covered basin where the plants remove nutrients, BOD/COD/TOC, suspended solids, heavy metals, etc. Batch treatment and flow-through systems, using single and multiple cell units, are all possible. The treated wastewater is reused in a natural environment or recharged to the underground, becoming new groundwater. Hyacinths harvested from these systems can be used as a fertilizer/soil conditioner after composting, an animal feed, and a source of methane when anaerobically digested.

Aqueduct A pipe, conduit, or channel designed to transport water from a remote source, usually by gravity.

Aquifer A natural underground geological formation, often of sand or gravel, that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses.

Aquifer (confined) Soil or rock below the land surface that is saturated with water. There are layers of impermeable material both above and below it, and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

Aquifer (unconfined) An aquifer whose upper water surface (water table) is at atmospheric pressure and thus is able to rise and fall.

Area of cropland An area of cropland that has been subdivided into several strips is not a single field. Rather, each strip represents an individual field unit.

Area source A source of air pollution that is released over an area that cannot be classified as a point source. Area sources can include vehicles and other small engines, small businesses and household activities, or biogenic sources such as a forest that releases hydrocarbons.

Area-capacity curve A graph showing the relation between the surface area of the water in a reservoir and the corresponding volume.

Arid Pertaining to climatic conditions or a soil that lacks humidity.

Arid climate A climate characterized by less than 10 in. (25.4 cm) of annual rainfall.

Artesian water Groundwater that is under pressure when tapped by a well and is able to rise above the level at which it is first encountered. It may or may not flow out at ground level. The pressure in such

an aquifer commonly is called artesian pressure, and the formation containing artesian water is an artesian aquifer or confined aquifer. See Flowing well.

Artificial recharge A process where water is put back into groundwater storage from surface-water supplies such as irrigation or induced infiltration from streams or wells.

Average discharge In the annual series of the US Geological Survey's reports on surface-water supply, average discharge is the arithmetic average of all complete water years of record whether or not they are consecutive. Average discharge is not published for less than 5 years of record. The term "average" is generally reserved for average of record, and "mean" is used for averages of shorter periods, namely, daily mean discharge.

Backwater (1) Water backed up or retarded in its course as compared with its normal or natural condition of flow. (2) The increased depth of water upstream from an obstruction (such as dam, ice, weed, etc.) in a stream channel caused by the existence of such obstruction. (3) a water reserve obtained at high tide, and discharged at low tide.

Bagged sewage sludge Sewage sludge that is sold or given away in a bag or another container (i.e., either an open or a closed receptacle containing 1 metric ton or less of sewage sludge).

Bank The margins of a channel. Banks are called right or left as viewed facing in the direction of the flow.

Bank storage The water absorbed into the banks of a stream channel, when the stages rise above the water table in the bank formations, then returns to the channel as effluent seepage when the stages fall below the water table.

Bankfull stage Stage at which a stream first overflows its natural banks.

Base A substance that has a pH of more than 7, which is neutral. A base has less free hydrogen ions (H^+) than hydroxyl ions (OH^-).

Base discharge (for peak discharge) In the US Geological Survey's annual reports on surface-water supply, this is the discharge above which peak discharge data are published. The base discharge at each station is selected so that an average of about three peaks a year will be presented. (See also Partial-duration flood series.)

Base flow Sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced streamflows. Natural base flow is sustained largely by groundwater discharges. (Also see Base runoff.)

Base runoff Sustained or fair weather runoff. In most streams, base runoff is composed largely of groundwater effluent. The term base flow is often used in the same sense as base runoff. However, the distinction is the same as that between streamflow and runoff. When the concept in the terms base flow and base runoff is that of the natural flow in a stream, base runoff is the logical term.

Baseline A reference condition against which changes or trends are judged—usually a set of conditions that exist at a particular point in time.

Basic hydrologic data Includes inventories of features of land and water that vary only from place to place (topographic and geological maps are examples) and records of processes that vary with both place and time. (Records of precipitation, streamflow, groundwater, and quality-of-water analyses are examples.)

Basic hydrologic information It is a broader term that includes surveys of the water resources of particular areas and a study of their physical and related economic processes, interrelations, and mechanisms.

Basic-stage flood series See Partial-duration flood series.

Bedrock The solid rock beneath the soil and superficial rock. A general term for solid rock that lies beneath soil, loose sediments, or other unconsolidated material.

Benchmark A concentration or other accepted measures against which environmental conditions are compared.

Benefit maximization The process of increasing benefits to the greatest extent possible within constraints such as limitation on financial resources.

Benefits A good, service, or attribute of a good or service that promotes or enhances the well-being of an individual, an organization, or a natural system.

Best available technology (1) A method that has been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint and point sources. (2) The water treatment (s) that the government (such as the US Environmental Protection Agency) certifies to be the most effective for removing a contaminant.

Bioaccumulative compound A compound that tends to accumulate in tissues and build up in food webs. Some bioaccumulative compounds can potentially have adverse effects on ecosystems or human health.

Bioavailable The state of a toxicant such that there is increased physicochemical access to the toxicant by an organism. The less the bioavailability of a toxicant, the less its toxic effect on an organism.

Biogenic source An air emission source created by some sort of biological activity. Examples include emissions resulting from microbial activity in soils and emissions from trees and other vegetation. Emissions from biogenic sources are a subset of emissions from natural sources (see Natural source).

Biological balance The interrelationships among organisms, including the structure of food webs and the ability of ecological systems to maintain themselves over time. Balance is a dynamic characteristic, rather than a fixed state.

Biological diversity The variety and variability among living organisms and the ecological complexes in which they occur. Though it most often refers to the numbers of species, the term can apply to levels of organization ranging from genes to ecosystems.

Biomarker A molecular or cellular indicator (or "marker") of an event or condition (exposure, effect, susceptibility) in a biological system or sample. It is the product of an interaction between a contaminant and some target molecule or cell.

Biomarker of effect A measure of disease progression, representing a measurable alteration at the molecular, cellular, or some other structural level in the body that can be recognized as a potential or established adverse health effect. Such a biomarker can indicate a biological response or health effect related to a chemical or other stressor; however, it is not always possible to link a biomarker with exposure to a single substance.

Biomarker of exposure The level of a contaminant or its metabolite collected from the body or from substances produced or excreted within biological systems. In humans, this measurement can reflect the amount of the contaminant that is stored in the body, and is sometimes referred to as the body burden. It indicates the level of exposure.

Biomarker of susceptibility A measurement of individual factors that can affect response to environmental agents. Examples include enzymes whose presence or absence may reflect a particular genetic condition.

Biomonitoring The measurement of human tissues or excreta from biological systems for direct or indirect evidence of exposure to chemical, biological, or radiological substances.

Biosolids Biosolids are solids, semisolids, or liquid materials, resulting from biological treatment of domestic sewage that has been sufficiently processed to permit these materials to be safely land applied. The term of biosolids was introduced by the wastewater-treatment industry in the early 1990s and has been recently adopted by the United States Environmental Protection Agency

(US EPA) to distinguish high-quality, treated sewage sludge from raw sewage sludge and from sewage sludge containing large amounts of pollutants.

Biotic environment The biological component of an ecosystem, including plants and animals.

Braiding of river channels Successive division and rejoining (of riverflow) with accompanying islands is the important characteristic denoted by the synonymous terms, braided or anastomosing stream. A braided stream is composed of anabranches.

Bulk sewage sludge Sewage sludge that is not sold or given away in a bag or other container for application to the land.

Capillary action The means by which liquid moves through the porous spaces in a solid, such as soil, plant roots, and the capillary blood vessels in our bodies, due to the forces of adhesion, cohesion, and surface tension. Capillary action is essential in carrying substances and nutrients from one place to another in plants and animals.

Catchment area See Drainage basin.

Ceiling concentration limits (CCL) The ceiling concentration limits are the maximum concentrations of the nine trace elements allowed in biosolids to be land applied. Sewage sludge exceeding the ceiling concentration limit for even one of the regulated pollutants is not classified as biosolids and, hence, cannot be land applied.

Channel A conduit formed by the flow of water and debris. The time and volume characteristics of water or debris can be altered by man, by climate change, or by alterations in protective vegetal cover on the land of the watershed. The stream channel adjusts to the new set of conditions.

Channel (watercourse) An open conduit either naturally or artificially created which periodically or continuously contains moving water or which forms a connecting link between two bodies of water. River, creek, run, branch, anabranch, and tributary are some of the terms used to describe natural channels. Natural channels may be single or braided (see Braiding of river channels). Canal and floodway are some of the terms used to describe artificial channels.

Channel storage The volume of water at a given time in the channel or over the flood plain of the streams in a drainage basin or river reach. Channel storage is great during the progress of a flood event.

Channelization The practice of straightening a waterway to remove meanders and make water flow faster. Sometimes concrete is used to line the sides and bottom of the channel.

Chronic health effect The possible result of exposure over many years to a drinking water contaminant at levels above its maximum contaminant level (MCL).

Clarity A measure of the amount of particles suspended in water, determined by using a disk or turbidity test.

Class I sludge management facility Publicly owned treatment works (POTWs) required to have an approved pretreatment program under 40 CFR 403.8(a), including any POTW located in a state that has elected to assume local pretreatment program responsibilities under 40 CFR 403.10(e). In addition, the Regional Administrator or, in the case of approved state programs, the Regional Administrator in conjunction with the State Director has the discretion to designate any treatment works treating domestic sewage (TWTDS) as a Class I sludge management facility.

Clean Water Act (CWA) The US law, codified generally as 33 USC 1251–1387, that establishes a regulatory and enforcement program administered by the US EPA to control pollutant discharges into US waters.

Cleanup Action taken to deal with a release (or threat of release) of a hazardous substance that could affect humans and/or the environment. This term is sometimes used interchangeably with the terms "remedial action," "removal action," "response action," and "corrective action."

Climate The sum total of the meteorologic elements that characterize the average and extreme condition of the atmosphere over a long period of time at any one place or region of the Earth's surface. The collective state of the atmosphere at a given place or over a given area within a specified period of time.

Climate change A term sometimes used to refer to all forms of climatic inconsistency; because the Earth's climate is never static, the term is more properly used to imply a significant change from one climatic condition to another. In some cases, "climate change" has been used synonymously with "global warming." Scientists, however, tend to use "climate change" in the wider sense to also include natural changes in climate.

Climatic year A continuous 12-month period during which a complete annual cycle occurs, arbitrarily selected for the presentation of data relative to hydrologic or meteorologic phenomena. The climatic year is usually designated by the calendar year during which most of the 12 months occur. (See Water year.)

Cloudburst A torrential downpour of rain, which by its spottiness and relatively high intensity suggests the bursting and discharge of a whole cloud at once.

Coastal waters Waters at the interface between terrestrial environments and the open ocean. Many unique habitats lie in coastal waters—for example, estuaries, coastal wetlands, sea grass meadows, coral reefs, mangrove and kelp forests, and upwelling areas.

Coliform A group of related bacteria whose presence in drinking water may indicate contamination by disease-causing, pathogenic microorganisms.

Combined sewers and combined sewer overflow (CSO) Pipes that carry both storm water and household sewage to sewage treatment plants. During a big storm, they may overflow and dump untreated sewage into streams, lakes, and coastal waters. These overflows are called combined sewer overflows or CSOs.

Commercial water use Water used for motels, hotels, restaurants, office buildings, other commercial facilities, and institutions. Water for commercial uses comes both from public-supplied sources, such as a county water department, and self-supplied sources, such as local wells.

Community In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest.

Community water system A water system which supplies drinking water to 25 or more of the same people year-round in their residences.

Compliance The act of meeting all state and federal drinking water regulations.

Concentration time See Time of concentration.

Concordant flows Flows at different points in a river system that have the same recurrence interval or the same frequency of occurrence. It is most often applied to flood flows.

Condensation The process by which water vapor changes from the vapor state into the liquid or solid state. Water drops on the outside of a cold glass of water are condensed water. It is the reverse of evaporation.

Condition of ecology The state of a resource, generally reflecting a combination of physical, chemical, and biological characteristics such as temperature, water clarity, chemical composition, or the status of biological communities. The condition of fresh surface waters, groundwater, wetlands, coastal waters, recreational waters, and consumable fish and shellfish. (Also see Ecological condition.)

Conservation storage Storage of water for later release for useful purposes such as municipal water supply, power, or irrigation in contrast with storage capacity used for flood control.

Constructed wetland or created wetland A wetland at a site where it did not formerly occur. Constructed/created wetlands are designed to meet a variety of human benefits including, but not limited to, the treatment of water pollution discharges (e.g., municipal wastewater, storm water) and the mitigation of wetland losses permitted under Section 404 of the Clean Water Act.

Construction and demolition debris Waste materials generated during the construction, renovation, and demolition of buildings, roads, and bridges. Construction and demolition debris often contains bulky, heavy materials such as concrete, wood (from buildings), asphalt (from roads and roofing shingles), gypsum (from drywall), metals, bricks, glass, plastics, building components (doors, windows, plumbing fixtures), and trees, stumps, earth, and rock from clearing sites.

Consumptive use (1) The quantity of water absorbed by the crop and transpired or used directly in the building of plant tissue together with that evaporated from the cropped area. (2) The quantity of water transpired and evaporated from a cropped area or the normal loss of water from the soil by evaporation and plant transpiration. (3) The quantity of water discharged to the atmosphere or incorporated in the products of the process in connection with vegetative growth, food processing, or an industrial process. (4) The part of water withdrawn that is evaporated, transpired by plants, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment. Also referred to as water consumed.

Consumptive use, net (1) The consumptive use decreased by the estimated contribution by rainfall toward the production of irrigated crops. (2) Net consumptive use is sometimes called crop irrigation requirement.

Consumptive waste The water that returns to the atmosphere without benefiting man.

Contaminant (1) Anything found in the environment (including microorganisms, minerals, chemicals, radionuclides) which may be harmful to human health. (2) Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.

Contaminated land Land that has been polluted with hazardous materials and requires cleanup or remediation. Contaminated lands include sites contaminated as a result of improper handling or disposal of toxic and hazardous wastes, sites where improper handling or accidents released toxic or hazardous materials that are not wastes, and sites where toxics may have been deposited by wind or flooding.

Contents The volume of water in a reservoir. Unless otherwise indicated reservoir content is computed on the basis of a level pool and does not include bank storage.

Control A natural constriction of the channel, a long reach of the channel, a stretch of rapids, or an artificial structure downstream from a gaging station that determines the stage-discharge relation at the gage. A control may be complete or partial. A complete control exists where the stage-discharge relation at a gaging station is entirely independent of fluctuations in stage downstream from the control. A partial control exists where downstream fluctuations have some effect upon the stage-discharge relation at a gaging station. A control, either partial or complete, may also be shifting. Most natural controls are shifting to a degree, but a shifting control exists where the stage-discharge relation experiences frequent changes owing to impermanent bed or banks.

Conveyance loss Water that is lost in transit from a pipe, canal, or ditch by leakage or evaporation. Generally, the water is not available for further use; however, leakage from an irrigation ditch, for example, may percolate to a groundwater source and be available for further use.

Correlation The process of establishing a relation between a variable and one or more related variables. Correlation is simple if there is only one independent variable; multiple, if there is more than one independent variable. For gaging-station records, the usual variables are the short-term gaging-station record and one or more long-term gaging-station records.

Correlative estimate A discharge determined by correlation. A correlative estimate represents a likely value of the discharge for any particular period—commonly a month—according to a specified method of analysis.

Cost minimization The process of reducing costs to the lowest possible amount given constraints such as requirements that a specified level of benefits or other resources be attained or provided.

Criteria pollutants A group of six widespread and common air pollutants that US EPA regulates on the basis of standards set to protect public health or the environment (see National Ambient Air Quality Standards). The six criteria pollutants are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide.

Crop group Individual farm fields that are managed in the same manner, with the similar yield goals, are called a crop group.

Crop management The management involves crop group identification, crop nitrogen deficit determination, crop nitrogen fertilizer rate calculation, and crop yield optimization.

Crop nitrogen deficit (CND) Crop nitrogen deficit (CND) equals to anticipated crop nitrogen fertilizer rate (CNFR) minus all past PAN sources (PAN-past) and current planned non-biosolids PAN sources (PAN-plan) in the unit of lb N/acre. Previous biosolid carry-over nitrogen is included in this calculation.

Crop nitrogen fertilizer rate (CNFR) CNFR is a rate (lb N/acre) = (yield) (UNFR), where UNFR is the unit nitrogen fertilizer rate (lb N/unit crop yield) and yield is the crop harvested or crop yield (bu/acre or ton/acre).

Crop year The basic time management unit is often called the crop year or planting season. The crop year is defined as the year in which a crop receiving the biosolids/manure treatment is harvested. For example, fall applications of biosolids/manure in 2000 intended to provide nutrients for a crop to be harvested in 2001 are earmarked for crop year 2001. Likewise, biosolids/manure applied immediately prior to planting winter wheat in October 2000 should be identified as fertilizer intended for crop year 2001 because the wheat will be harvested in the summer of 2001.

Crop yield It is the crop harvested in the unit of bu/acre or ton/acre.

Cryology Science of ice and snow.

Cryptosporidium A microorganism commonly found in lakes and rivers, which is highly resistant to disinfection and has caused several large outbreaks of gastrointestinal illness, with symptoms that include diarrhea, nausea, and/or stomach cramps.

Cumulative pollutant loading rate (CPLR) CPLR equals to the total amount of pollutant that can be applied to a site in its lifetime by all bulk biosolid applications meeting CCL. It is the maximum amount of an inorganic pollutant that can be applied to an area of land. This term applies to bulk sewage sludge that is land applied.

Current meter An instrument for measuring the speed of flowing water. The Geological Survey uses a rotating cup meter.

CWA §101 The objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters.

CWA §303d This section of the Clean Water Act (CWA) requires states to identify waters that do not or are not expected to meet applicable water quality standards with technology-based controls alone. Waters impacted by thermal discharges are also to be identified. After the identification and priority ranking of water quality-limited waters are completed, states are to develop TMDLs at a level necessary to achieve the applicable state water quality standards.

CWA §314 This section of the Clean Water Act (CWA) establishes the Clean Lakes Program, which supports activities from initial identification of potential water quality problems through post-restoration monitoring. Cooperative grants provide funding for these activities.

CWA §319 This section of the Clean Water Act (CWA) requires states to develop nonpoint-source control programs. The US EPA awards grants to implement approved programs that include, as appropriate, nonregulatory and regulatory programs for enforcement, technical assistance, financial assistance, education, training, technology transfer, and demonstration projects.

CWA §320 This section of the Clean Water Act (CWA) establishes the National Estuary Program (NEP), a demonstration program designed to show how estuaries and their living resources can be protected through comprehensive, action-oriented management. Participation in the NEP is limited to estuaries determined by the US EPA Administrator to be of "national significance" after nomination by the Governors of the states in which the estuaries are located.

CWA §402 This section of the Clean Water Act (CWA) establishes the National Pollutant Discharge Elimination System (NPDES), which provides for the issuance of point-source permits to discharge any pollutant or combination of pollutants, after opportunity for public hearing.

CWA §404 The discharges of dredged or fill material into wetlands is regulated under this section of the CWA. Permits may be issued after notice and opportunity for public hearings.

Cycle A regularly recurring succession of events such as the cycle of the seasons. Use of cycle to describe a group of wet years followed or preceded by a group of dry years is to be avoided.

Dead storage The volume in a reservoir below the lowest controllable level.

Deleted NPL site A site that has been deleted from the Superfund National Priorities List because its cleanup goals have been met and there is no further need for federal action. (See Superfund and National Priorities List.)

Dependable yield, *n*-years The minimum supply of a given water development that is available on demand, with the understanding that lower yields will occur once in *n*-years, on the average.

Depletion The progressive withdrawal of water from surface- or groundwater reservoirs at a rate greater than that of replenishment. (See Recession curve and Streamflow depletion.)

Depression storage The volume of water contained in natural depressions in the land surface, such as puddles.

Desalination The removal of salts from saline water to provide freshwater. This method is becoming a more popular way of providing freshwater to populations.

Designated use Simple narrative description of water quality expectations or water quality goals. A designated use is a legally recognized description of a desired use of the waterbody, such as (1) support of communities of aquatic life, (2) body contact recreation, (3) fish consumption, and (4) public drinking water supply. These are uses that the state or authorized tribe wants the waterbody to be healthy enough to fully support. The US Clean Water Act requires that waterbodies attain or maintain the water quality needed to support designated uses.

Direct runoff The runoff entering stream channels promptly after rainfall or snowmelt. Superposed on base runoff, it forms the bulk of the hydrograph of a flood.

Discharge In its simplest concept discharge means outflow; therefore, the use of this term is not restricted as to course or location, and it can be applied to describe the flow of water from a pipe or from a drainage basin. If the discharge occurs in some course or channel, it is correct to speak of the discharge of a canal or of a river. It is also correct to speak of the discharge of a canal or stream into a lake, a stream, or an ocean. (See also Streamflow and Runoff.) The data in the reports of the Geological Survey on surface water represent the total fluids measured. Thus, the terms discharge, streamflow, and runoff represent water with the solids dissolved in it and the sediment mixed with

it. Of these terms, discharge is the most comprehensive. The discharge of drainage basins is distinguished as follows: (1) yield, total water runout or crop, includes runoff plus underflow; (2) runoff, that part of water yield that appears in streams; and (3) streamflow, the actual flow in streams, whether or not subject to regulation, or underflow. Each of these terms can be reported in total volumes (such as acre-feet) or time rates (such as cubic feet per second or acre-feet per year). The differentiation between runoff as a volume and streamflow as a rate is not accepted.

Discharge The volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

Discharge rating curve See Stage-discharge relation.

Disinfectant A chemical (commonly chlorine, chloramine, or ozone) or physical process (e.g., ultraviolet light) that kills microorganisms such as bacteria, viruses, and protozoa.

Dissolved oxygen (DO) The amount of oxygen dissolved in water. The amount is usually expressed in parts per million (ppm) or milligrams per liter (mg/L).

Distressed watershed It is a watershed which has aquatic life and health that is impaired by nutrients (nitrogen and phosphorus) from agricultural land uses, such as land application. Threats to public health, drinking water supplies, recreation, and public safety are also taken into consideration if a watershed is designated as a distressed watershed.

Distribution graph (distribution hydrograph) A unit hydrograph of direct runoff modified to show the proportions of the volume of runoff that occurs during successive equal units of time.

Distribution system A network of pipes leading from a treatment plant to customers' plumbing systems.

Diversion The taking of water from a stream or other body of water into a canal, pipe, or other conduit.

Domestic septage Either a liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, or similar treatment works that receives only domestic sewage. This does not include septage resulting from treatment of wastewater with a commercial or industrial component.

Domestic water use Water used for household purposes, such as drinking; food preparation; bathing; washing clothes, dishes, and dogs; flushing toilets; and watering lawns and gardens. About 85 % of domestic water is delivered to homes by a public-supply facility, such as a county water department. About 15 % of the nation's population supply their own water, mainly from wells.

Double-mass curve A plot on arithmetic cross-section paper of the cumulated values of one variable against the cumulated values of another or against the computed values of the same variable for a concurrent period of time.

Drainage area The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is enclosed by a drainage divide.

Drainage basin (1) A part of the surface of the Earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water; (2) land area where precipitation runs off into streams, rivers, lakes, and reservoirs; (3) a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large drainage basins, like the area that drains into the Mississippi River, contain thousands of smaller drainage basins. Also called a "watershed."

Drainage density Length of all channels above those of a specified stream order per unit of drainage area.

Drainage divide The rim of a drainage basin. (See Watershed.)

Drawdown A lowering of the groundwater surface caused by pumping.

Drinking water quality Refers to whether contaminants are present in water that people drink, including water from the tap, private wells, hauled water, untreated surface-water sources, and bottled water, at levels that could affect human health.

Drinking water standards Regulations that the government, such as the US EPA, sets to control the level of contaminants in the nation's drinking water. Enforceable standards include maximum contaminant levels (MCLs) and treatment techniques (TTs) (see separate entries for each). Drinking water standards apply to all public water systems (see Public water system).

Drip irrigation A common irrigation method where pipes or tubes filled with water slowly drip onto crops. Drip irrigation is a low-pressure method of irrigation and less water is lost to evaporation than high-pressure spray irrigation.

Drop structure A natural or man-placed structure that disrupts the continuous surface flow pattern in a river or stream by producing a pooling of water behind the structure and a rapid drop in the surface gradient for water flowing over the structure; used to improve habitat conditions for aquatic life and to increase the air (especially oxygen) content of water.

Drought A period of deficient precipitation or runoff extending over an indefinite number of days, but with no set standard by which to determine the amount of deficiency needed to constitute a drought. Thus, there is no universally accepted quantitative definition of drought; generally, each investigator establishes his/her own definition. When in an area that is ordinarily classed as humid, natural vegetation becomes desiccated or defoliates unseasonably and crops fail to mature owing to lack of precipitation, or when precipitation is insufficient to meet the needs of established human activities, drought conditions may be said to prevail. Although water for irrigation or other uses in arid areas is always limited, special shortages in such areas are also regarded as droughts. Unsatisfactory distribution of precipitation throughout the year may be as effective a factor in causing a drought as a shortage in the total amount. Temperature and wind may also play an important part, especially in relation to the damage done.

Duration curve See Flow-duration curve for one type.

Ecological condition A term referring to the state of the physical, chemical, and biological characteristics of the environment and the processes and interactions that connect them.

Ecological connectivity A term referring to the connected system of open space throughout an ecosystem and adjacent ecosystems. Includes the presence of ecotones, the transitional regions between ecosystems.

Ecological processes The metabolic functions of ecosystems—energy flow, elemental cycling, and the production, consumption, and decomposition of organic matter.

Ecological system A hierarchically nested area that includes all living organisms (people, plants, animals, and microorganisms), their physical surroundings (such as soil, water, and air), and the natural cycles that sustain them.

Ecology The study of the relationships between the environment and the living organisms and beings present.

Ecoregion (1) An area within which the ecosystems—and the type, quality, and quantity of environmental resources—are generally similar. An ecoregion can serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. Several different classification schemes have been developed at various resolutions; (2) Ecological region that has broad similarities with respect to soil, relief, and dominant vegetation.

Ecosystem The interacting system of a particular biological community and its nonliving environmental surroundings or a class of such systems (e.g., forests or wetlands).

Effective precipitation (rainfall) (1) That part of the precipitation that produces runoff; (2) a weighted average of current and antecedent precipitation that is "effective" in correlating with runoff; (3) as described by the US Bureau of Reclamation, that part of the precipitation falling on an irrigated area that is effective in meeting the consumptive use requirements.

Effluent Water that flows from a sewage treatment plant after it has been treated.

Emission factor The relationship between the amount of pollution produced by a particular source and the amount of raw material processed. For example, an emission factor for a blast furnace making iron might be pounds of particulates emitted per ton of raw materials processed.

Emission inventory A listing, by source and pollutant, of the amount of air pollutants discharged into the atmosphere. Emission inventories can be based on emissions estimates, emissions measurements, or both.

End state Any one of a number of ecosystem characteristics observed at a point in time. The term is commonly used to represent the results of ecological processes.

Endpoint A biological or ecological characteristic that is the basis for evaluation or measurement.

Energy cycling The movement, or flow, and storage of energy among production and use components of ecological and physiological systems.

Enhancement An activity increasing one or more natural or artificial wetland functions. For example, the removal of a point-source discharge impacting a wetland.

Ephemeral waters Waterbodies (e.g., streams or wetlands) that contain water for brief periods, usually in direct response to a precipitation event. Ephemeral waters generally flow for a shorter time period than intermittent waters, although in some cases the terms are used interchangeably (see Intermittent waters).

Epilimnion See Thermal stratification.

Erosion The process in which a material is worn away by a stream of liquid (water) or air, often due to the presence of abrasive particles in the stream.

Estuary A place where fresh- and saltwater mix, such as a bay, salt marsh, or where a river enters an ocean.

Eutrophication Enrichment of an aquatic ecosystem with nutrients (nitrogen, phosphorus) that accelerate biological productivity (growth of algae and weeds) and an undesirable accumulation of algal biomass.

Evaporation (1) The process by which water is changed from the liquid or the solid state into the vapor state; (2) the process of liquid water becoming water vapor, including vaporization from water surfaces, land surfaces, and snow fields, but not from leaf surfaces. See Transpiration. In hydrology, evaporation is vaporization that takes place at a temperature below the boiling point.

Evaporation opportunity (relative evaporation) The ratio of the rate of evaporation from a land or water surface in contact with the atmosphere to the evaporativity under existing atmospheric conditions. It is the ratio of actual to potential rate of evaporation, generally stated as a percentage. The opportunity for a given rate of evaporation to continue is determined by the available moisture supply.

Evaporation pan An open tank used to contain water for measuring the amount of evaporation. The US Weather Bureau Class A pan is 4 ft (1.22 m) in diameter, 10 in. (25.4 cm) deep, set up on a timber grillage so that the top rim is about 16 in. (40.64 cm) from the ground. The water level in the pan during the course of observation is maintained between 2 and 3 in. (5.08 and 7.53 cm) below the rim.

Evaporation, total The sum of water lost from a given land area during any specific time by transpiration from vegetation and building of plant tissue; by evaporation from water surfaces, moist soil, and snow; and by interception. It has been variously termed "evaporation," "evaporation from land areas," "evapotranspiration," "total loss," "water losses," and "fly-off."

Evaporativity (potential rate of evaporation) The rate of evaporation under the existing atmospheric conditions from a surface of water that is chemically pure and has the temperature of the atmosphere.

Evapotranspiration (1) Water withdrawn from a land area by evaporation from water surfaces and moist soil and plant transpiration; (2) the sum of evaporation and transpiration; (3) the combined conversion of water to water vapor and loss resulting from both evaporation and transpiration.

Evapotranspiration, potential See Potential evapotranspiration.

Exceptional quality sewage sludge Sewage sludge that meets the most stringent limits for the three sludge quality parameters. In gaging sewage sludge quality, US EPA determined that three main parameters of concern should be considered: (1) pollutant levels; (2) the relative presence or absence of pathogenic organisms, such as salmonella and E. coli bacteria, enteric viruses, or viable helminth ova; and (3) the degree of attractiveness of the sewage sludge to vectors, such as flies, rats, and mosquitoes, that could potentially come in contact with pathogenic organisms and spread disease. Given these three variables, there can be a number of possible sewage sludge qualities. The term exceptional quality (EQ), which does not appear in the Part 503 regulation, is used to describe sewage sludge that meets the highest quality for all three of these sewage sludge quality parameters.

Excessive rainfall See Rainfall, excessive.

Exemption State or US EPA permission for a water system not to meet a certain drinking water standard. An exemption allows a system additional time to obtain financial assistance or make improvements in order to come into compliance with the standard. The system must prove that (1) there are compelling reasons (including economic factors) why it cannot meet an MCL or treatment technique, (2) it was in operation on the effective date of the requirement, and (3) the exemption will not create an unreasonable risk to public health. The state must set a schedule under which the water system will comply with the standard for which it received an exemption.

Exposure This is the amount of a chemical, physical, or biological contaminant at the outer boundary of the human or animal body available for exchange or intake via inhalation, ingestion, or skin or eye contact.

Extent The amount and distribution of a resource, which may be measured in terms of spatial area, volume, depth, or flow (e.g., for water resources). ROE questions address the extent of fresh surface waters, groundwater, wetlands, and coastal waters.

Extraction and mining waste Soil and rock generated during the process of gaining access to the ore or mineral body, as well as water that infiltrates the mine during the extraction process. This category also includes certain wastes associated with the beneficiation of ores and minerals, including wastes from the following activities: crushing, grinding, washing, dissolution, crystallization, filtration, sorting, sizing, drying, sintering, pelletizing, briquetting, calcining to remove water and/or carbon dioxide, roasting in preparation for leaching (except where the roasting/leaching sequence produces a final or intermediate product that does not undergo further beneficiation or processing), gravity concentration, magnetic separation, electrostatic separation, floatation, ion exchange, solvent extraction, electrowinning, precipitation, amalgamation, and heap, dump, vat, tank, and in situ leaching.

Farm field The farm field is the basic management unit used for all farm nutrient management, defined as "the fundamental unit used for cropping agricultural products."

Feed crop Crops produced primarily for consumption by animals. These include, but are not limited to, corn and grass. For a crop to be considered a feed crop, it has to be produced for consumption by animals (e.g., grass grown to prevent erosion or to stabilize an area is not considered a feed crop).

Fiber crop Crops, such as flax and cotton, that were included in Part 503 because products from these crops (e.g., cottonseed oil) may be consumed by humans.

Field capacity See Field-moisture capacity.

Field-moisture capacity The quantity of water which can be permanently retained in the soil in opposition to the downward pull of gravity.

Field-moisture deficiency The quantity of water which would be required to restore the soil moisture to field-moisture capacity.

Final NPL site A site that has been formally added to the Superfund National Priorities List. (See Superfund and National Priorities List.)

Finished water Water that has been treated and is ready to be delivered to customers.

Firn (firn snow) Old snow on the top of glaciers, granular, and compact but not yet converted into ice. It is a transitional stage between snow and ice.

Firn line The highest level to which the fresh snow on a glacier's surface retreats during the melting season. The line separating the accumulation area from the ablation area.

Flood (1) An overflow or inundation that comes from a river or other body of water and causes or threatens damage; (2) any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream; (3) a relatively high flow as measured by either gage height or discharge quantity; (4) an overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two essential characteristics: the inundation of land is temporary, and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean.

Flood crest See Flood peak.

Flood event See Flood wave.

Flood peak The highest value of the stage or discharge attained by a flood, thus peak stage or peak discharge. Flood crest has nearly the same meaning, but since it connotes the top of the flood wave, it is properly used only in referring to stage—thus crest stage, but not crest discharge.

Flood plain (1) A strip of relatively smooth land bordering a stream built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. It is called a living flood plain if it is overflowed in times of high water but a fossil flood plain if it is beyond the reach of the highest flood. (2) The lowland that borders a river, usually dry but subject to flooding. (3) That land outside of a stream channel described by the perimeter of the maximum probable flood. (4) A strip of relatively flat and normally dry land alongside a stream, river, or lake that is covered by water during a flood.

Flood plane The position occupied by the water surface of a stream during a particular flood. Also, loosely, the elevation of the water surface at various points along the stream during a particular flood.

Flood profile A graph of elevation of the water surface of a river in flood, plotted as ordinate, against distance, measured in the downstream direction, plotted as abscissa. A flood profile may be drawn to show elevation at a given time or crests during a particular flood or to show stages of concordant flows.

Flood routing The process of determining progressively the timing and shape of a flood wave at successive points along a river.

Flood stage (1) The elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured; (2) the gage height of the lowest bank of the reach in which the gage is situated. The term "lowest bank" is, however, not to be taken to mean an unusually low place or break in the natural bank through which the water inundates an unimportant and small area. The stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured. See also Bankfull stage.

Flood wave A distinct rise in stage culminating in a crest and followed by recession to lower stages.

Flood zone The land bordering a stream which is subject to floods of about equal frequency, for example, a strip of the flood plain subject to flooding more often than once but not as frequently as twice in a century.

Flood, 100-year A 100-year flood does not refer to a flood that occurs once every 100 years, but to a flood level with a 1 % chance of being equaled or exceeded in any given year.

Flood, maximum probable The largest flood for which there is any reasonable expectancy in this climatic era.

Flood-control storage Storage of water in reservoirs to abate flood damage. (See Retarding reservoir.)

Flood-frequency curve (1) A graph showing the number of times per year on the average, plotted as abscissa, that floods of magnitude, indicated by the ordinate, are equaled or exceeded; (2) a similar graph but with recurrence intervals of floods plotted as abscissa.

Floods above a base See Partial-duration flood series.

Floodway (1) The channel of a river or stream and the parts of the flood plain adjoining the channel that are reasonably required to efficiently carry and discharge the floodwater or flood flow of a river or stream; (2) a part of the flood plain, otherwise leveled, reserved for emergency diversion of water during floods. A part of the flood plain which, to facilitate the passage of floodwater, is kept clear of encumbrances. The channel of a river or stream and those parts of the flood plains adjoining the channel, which are reasonably required to carry and discharge the floodwater or flood flow of any river or stream.

Flow-duration curve A cumulative frequency curve that shows the percentage of time that specified discharges are equaled or exceeded.

Flowing well/spring A well or spring that taps groundwater under pressure so that water rises without pumping. If the water rises above the surface, it is known as a flowing well.

Food crop Crops consumed by humans. These include, but are not limited to, fruits, grains, vegetables, and tobacco.

Forest influences Effects resulting from the presence of forest or brush upon climate, soil water, runoff, streamflow, floods, erosion, and soil productivity.

Forestland Tract of land thick with trees and underbrush.

Fossil fuel combustion waste Waste from the combustion of oil, natural gas, or petroleum coke; the combustion of coal at electric utilities and independent power-producing facilities, nonutilities, and facilities with fluidized bed combustion technology; or the combustion of mixtures of coal and other fuels (i.e., coburning of coal with other fuels) where coal is at least 50 % of the total fuel.

Frazil (frazil ice) A French-Canadian term for fine spicular ice, derived from the French for cinders which this variety of ice most resembles. When formed in saltwater, it is known as lolly ice. It is composed of fine particles which, when first formed, are colloidal and not seen in the water in which they are floating.

Freshwater Water that contains less than 1,000 mg/L of dissolved solids; generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses.

Functions of wetland The roles wetlands serve which are of value to society or the environment.

Gage height (1) The water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term stage although gage height is more appropriate when used with a reading on a gage. (2) The height of the water surface above the gage datum (zero point).

Gaging station (1) A particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are obtained. (See also Stream-gaging station.) (2) A site on a stream, lake, reservoir, or other body of water where observations and hydrologic data are obtained. The US Geological Survey measures stream discharge at gaging stations.

Geographic information system (GIS) A tool that links spatial features commonly seen on maps with information from various sources ranging from demographics to pollutant sources.

Geomorphology The geological study of the evolution and configuration of land forms.

Geyser A geothermal feature of the Earth where there is an opening in the surface that contains superheated water that periodically erupts in a shower of water and steam.

Giardia lamblia A microorganism frequently found in rivers and lakes, which, if not treated properly, may cause diarrhea, fatigue, and cramps after ingestion.

Giardiasis A disease that results from an infection by the protozoan parasite *Giardia intestinalis*, caused by drinking water that is either not filtered or not chlorinated. The disorder is more prevalent in children than in adults and is characterized by abdominal discomfort, nausea, and alternating constipation and diarrhea.

Glacier (1) A huge mass of ice, formed on land by the compaction and recrystallization of snow, that moves very slowly downslope or outward due to its own weight. (2) Bodies of land ice that consist of recrystallized snow accumulated on the surface of the ground and that move slowly downslope.

Global climate change See Climate change.

Greenhouse gas Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

Greywater Wastewater from clothes washing machines, showers, bathtubs, hand washing, lavatories, and sinks.

Groundwater (1) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturate zone is called the water table; (2) water stored underground in rock crevices and in the pores of geological materials that make up the Earth's crust; (3) the supply of freshwater that is found under the Earth's surface in underground rock formations or soil; (4) water in the ground that is in the zone of saturation, from which wells, springs, and groundwater runoff are supplied; (5) the water that systems pump and treat from aquifers (natural reservoirs below the Earth's surface).

Groundwater outflow That part of the discharge from a drainage basin that occurs through the groundwater. The term "underflow" is often used to describe the groundwater outflow that takes place in valley alluvium (instead of the surface channel) and thus is not measured at a gaging station.

Groundwater recharge Inflow of water to a groundwater reservoir from the surface. Infiltration of precipitation and its movement to the water table is one form of natural recharge. Also, it is the volume of water added by this process.

Groundwater runoff That part of the runoff which has passed into the ground, has become groundwater, and has been discharged into a stream channel as spring or seepage water. See also Base runoff and Direct runoff.

Groundwater, confined Groundwater under pressure significantly greater than atmospheric, with its upper limit the bottom of a bed with hydraulic conductivity distinctly lower than that of the material in which the confined water occurs.

Groundwater, unconfined Water in an aquifer that has a water table that is exposed to the atmosphere.

Guttation The loss of water in liquid form from the uninjured leaf or stem of the plant, principally through water stomata.

Habitat The environment occupied by individuals of a particular species, population, or community.

Hardness A water quality indication of the concentration of alkaline salts in water, mainly calcium and magnesium. If the water you use is "hard," then more soap, detergent, or shampoo is necessary to raise a lather.

Hazardous air pollutants See Air toxics.

Hazardous waste Waste with properties that make it dangerous or potentially harmful to human health or the environment. The universe of hazardous wastes is large and diverse. Hazardous wastes can be liquids, solids, contained gases, or sludge. They can be the by-products of manufacturing processes or simply discarded commercial products, like cleaning fluids or pesticides. Hazardous waste is regulated under the Resource Conservation and Recovery Act (RCRA) Subtitle C (see RCRA hazardous waste for the regulatory definition). States can identify additional wastes as hazardous beyond those identified by the US EPA.

Headwater(s) (1) The source and upper reaches of a stream and also the upper reaches of a reservoir. (2) The water upstream from a structure or point on a stream. (3) The small streams that come together to form a river. Also may be thought of as any and all parts of a river basin except the mainstream river and main tributaries.

Health advisory A US EPA document that provides guidance and information on contaminants that can affect human health and that may occur in drinking water, but which the US EPA does not currently regulate in drinking water.

Health-based standards Standards based on contaminant concentrations in environmental media or exposure doses that are likely to be without an appreciable risk of adverse health effects in humans. (Some health-based standards allow for consideration of technological and cost limitations.)

Heat budget, annual (of a lake) The amount of heat necessary to raise the water from the minimum temperature of winter to the maximum temperature of summer.

Heavy metals Trace elements are found in low concentrations in the environment, such as water, soil, or biosolids. They are commonly referred to as either "heavy metals" or "trace elements" (e.g., copper, molybdenum, and zinc) which are nutrients needed for plant or animal growth in low concentrations, but all of these elements can be toxic to humans, animals, or plants at high concentrations. Possible hazards associated with a buildup of trace elements in the soil include their potential to cause phytotoxicity (i.e., injury to plants) or to increase the concentration of potentially hazardous substances in the food chain. Federal and state regulations have established standards for the following nine trace elements: arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), and zinc (Zn).

Hydraulic Referring to water or other fluids in motion.

Hydraulic fracturing A process of aquifer development in which fluid is injected at pressures that exceed the tensile stress of the aquifer, causing cracks to develop and propagate in the formation. These cracks serve as conduits for liquid flow to a production well. This process can be used in petroleum (nature gas) recovery. It can also be used for increasing water production in rocklike aquifers or for contaminant recovery.

Hydraulics A science that studies water or other fluids in motion.

Hydroelectric power water use The use of water in the generation of electricity at plants where the turbine generators are driven by falling water.

Hydrograph A graph showing stage, flow, velocity, or other properties of water with respect to time.

Hydrologic budget An accounting of the inflow to, outflow from, and storage in a hydrologic unit, such as a drainage basin, aquifer, soil zone, lake, reservoir, or irrigation project.

Hydrologic cycle (1) The cyclic transfer of water vapor from the Earth's surface via evapotranspiration into the atmosphere, from the atmosphere via precipitation back to the Earth, and through runoff into streams, rivers, and lakes, and ultimately into the oceans. (2) A convenient term to denote the circulation of water from the sea, through the atmosphere, to the land, and, thence, with many delays, back to the sea by overland and subterranean routes and in part by way of the atmosphere, also the many short circuits of the water that is returned to the atmosphere without reaching the sea.

Hydrologic equation The equation balancing the hydrologic budget.

Hydrology (1) The science encompassing the behavior of water as it occurs in the atmosphere, on the surface of the ground, and underground. (2) The science that relates to the water of the Earth. (3) The science treating of the waters of the Earth, their occurrence, distribution, and movements. (4) The science dealing with the properties, distribution, and circulation of water both on the surface and under the Earth. In practice the study of the water of the oceans and the atmosphere is considered part of the sciences of oceanography and meteorology.

Hyetograph Graphical representation of rainfall intensity against time.

Hypolimnion See Thermal stratification.

Hypoxia The occurrence of low dissolved oxygen concentrations in water. Hypoxia is generally defined with respect to saturation; because saturation levels vary with temperature and salinity, the concentration that defines hypoxia may vary seasonally and geographically. In practice, scientists often use a threshold of 2 ppm (mg/L), the generally accepted minimum required for most marine life to survive and reproduce.

Impaired waterbody A waterbody that does not meet the criteria that support its designated use.

Impermeable layer A layer of solid material, such as rock or clay, which does not allow water to pass through.

Impervious surface (1) A hard surface area that either prevents or retards the entry of water into the soil mantle or causes water to run off the surface in greater quantities or at an increased rate of flow. (2) A paved or other hard surface that does not allow water to penetrate. Common impervious surfaces include rooftops, walkways, patios, driveways, parking lots, storage areas, concrete or asphalt paving, and gravel roads.

Index A single number, derived from two or more environmental variables, that is intended to simplify complex information. For example, the Index of Biological Integrity combines several metrics of benthic community condition into a single index score.

Index period In the US EPA's aquatic resource monitoring, a term used to describe the portion of the year when data are collected. The index period is often selected based on ecological considerations.

Indicator A numerical value derived from actual measurements of a stressor, state or ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.

Indicator organism An indicator organism (e.g., fecal coliform) is a nonpathogenic organism whose presence implies the presence of pathogenic organisms. Indicator organisms are selected to be conservative estimates of the potential for pathogenicity.

Individual field unit An area of cropland that has been subdivided into several strips is not a single field. Rather, each strip represents an individual field unit.

Industrial nonhazardous waste Waste generated from processes associated with the production of goods and products, such as electric power generation and manufacturing of materials such as pulp and paper, iron and steel, glass, and concrete. This waste usually is not classified as municipal solid waste by the federal government, but some states may classify it as such if it enters the municipal solid waste stream.

Industrial source A term used in this report to describe air emissions sources of industrial origin. The report breaks industrial sources down into contributions from selected industries, as appropriate.

Industrial water use Water used for industrial purposes in such industries as steel, chemical, paper, and petroleum refining. Nationally, water for industrial uses comes mainly (80 %) from self-supplied sources, such as a local wells or withdrawal points in a river, but some water comes from public-supplied sources, such as the county/city water department.

Infiltration (1) Flow of water from the land surface into the subsurface; (2) the flow of a fluid into a substance through pores or small openings. It connotes flow into a substance in contradistinction to the word percolation, which connotes flow through a porous substance.

Infiltration capacity The maximum rate at which the soil, when in a given condition, can absorb falling rain or melting snow.

Infiltration index An average rate of infiltration, in inches per hour, equal to the average rate of rainfall such that the volume of rainfall at greater rates equals the total direct runoff.

Injection well Refers to a well constructed for the purpose of injecting treated wastewater directly into the ground. Wastewater is generally forced (pumped) into the well for dispersal or storage into a designated aquifer. Injection wells are generally drilled into aquifers that don't deliver drinking water, unused aquifers, or below freshwater levels.

Inorganic contaminants Mineral-based compounds such as metals, nitrates, and asbestos. These contaminants are naturally occurring in some water but can also get into water through farming, chemical manufacturing, and other human activities. The US EPA has set legal limits on 15 inorganic contaminants.

Interception The process and the amount of rain or snow stored on leaves and branches and eventually evaporated back to the air. Interception equals the precipitation on the vegetation minus stemflow and through fall.

Intermittent waters Waterbodies (e.g., streams or wetlands) that contain water for part of each year, due to precipitation events and some groundwater contributions. Intermittent streams and wetlands typically contain water for weeks or months, while "ephemeral" streams and wetlands contain water for briefer periods, but in some cases, these terms are used interchangeably (see Ephemeral waters).

Invasive species A nonindigenous plant or animal species that can harm the environment, the human health, or the economy.

Irrigated area The gross farm area upon which water is artificially applied for the production of crops, with no reduction for access roads, canals, or farm buildings.

Irrigation The controlled application of water to arable lands to supply water requirements not satisfied by rainfall.

Irrigation The controlled application of water for agricultural purposes through man-made systems to supply water requirements not satisfied by rainfall. Here's a quick look at some types of irrigation systems.

Irrigation efficiency The percentage of water applied that can be accounted for in soil-moisture increase.

Irrigation requirement The quantity of water, exclusive of precipitation, that is required for crop production. It includes surface evaporation and other economically unavoidable wastes.

Irrigation water use Water application on lands to assist in the growing of crops and pastures or to maintain vegetative growth in recreational lands, such as parks and golf courses.

Irrigation, supplemental See Supplemental irrigation.

Isohyet See Isohyetal line.

Isohyetal line (isohyet) A line drawn on a map or chart joining points that receive the same amount of precipitation.

Lag Variously defined as time from beginning (or center of mass) of rainfall to peak (or center of mass) of runoff.

Land application Land application is defined as the spreading, spraying, injection, or incorporation of liquid or semiliquid organic substances, such as sewage sludge, biosolids, livestock manure, compost, septage, legumes, and other types of liquid organic waste, onto or below the surface of the land to take advantage of the soil-enhancing qualities of the organic substances. These organic substances are land applied to improve the structure of the soil. It is also applied as a fertilizer to supply nutrients to crops and other vegetation grown in the soil. The liquid or semiliquid organic substances are commonly applied to agricultural land (including pasture and rangeland), forests, reclamation sites, public contact sites (e.g., parks, turf farms, highway median strips, golf courses), lawns, and home gardens. (See Spray irrigation for land application of wastewater.)

Land application site An area of land on which sewage sludge is applied to condition the soil or to fertilize crops or vegetation grown in the soil.

Land treatment unit A site where physical, chemical, and biological processes occurring in the topsoil layers (e.g., naturally occurring soil microbes and sunlight) are used to treat and contain waste. Hazardous waste is applied directly to the soil surface or incorporated into the upper layers of the soil, where its constituents are degraded, transformed, or immobilized. Liner systems or leachate collection and removal systems are not required for land treatment units. Closure consists primarily of placing a vegetative cover over the unit and certifying that hazardous constituent levels in the treatment zone do not exceed background levels.

Landfill A disposal site for solid wastes spread in layers, compacted to the smallest practical volume and covered by material (e.g., soil). Landfills are designed to isolate waste from the surrounding environment (e.g., groundwater, rain, air). Landfills are subject to requirements that include installing and maintaining a final cover, operating leachate collection and removal systems, maintaining and monitoring the leak detection system, groundwater monitoring, preventing storm water run-on and runoff, and installing and protecting surveyed benchmarks.

Leaching The process by which soluble materials in the soil, such as salts, nutrients, pesticide chemicals, or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

Lentic waters Ponds or lakes (standing water).

Levee A natural or man-made earthen barrier along the edge of a stream, lake, or river. Land alongside rivers can be protected from flooding by levees.

Limnology That branch of hydrology pertaining to the study of lakes.

Livestock operation A facility that raises animals such as cows, sheep, or hogs. Fecal coliform bacteria are present in livestock waste.

Livestock water use Water used for livestock watering, feedlots, dairy operations, fish farming, and other on-farm needs.

Living machine system A patented, man-made aquaculture wetland waste treatment system which adapts and enhances the ecological processes in a series of tidal wetland cells or basins. Each cell or basin is filled with special gravel that promotes the development of micro-ecosystems. A computer

controls fill and drain cycles, alternating anoxic (without oxygen) and aerobic (with oxygen) conditions. As wastewater moves through the system, the cells are alternately flooded and drained to create multiple tidal cycles each day, much like one finds in nature, resulting in high-quality reusable water.

Long-period variations Secular when a cycle or a change in trend is completed within a century, climatic when the period of change runs through centuries or a few millennia, and geological when the period runs into geological time.

Lotic waters Flowing waters, as in streams and rivers.

Low-flow frequency curve A graph showing the magnitude and frequency of minimum flows for a period of given length. Frequency is usually expressed as the average interval, in years, between recurrences of an annual minimum flow equal to or less than that shown by the magnitude scale.

Lysimeter Structure containing a mass of soil and designed to permit the measurement of water draining through the soil.

Macroinvertebrate Organism that lacks a backbone and is large enough to be seen with the naked eye.

Manure Any wastes discharged from livestock.

Marginal costs The incremental cost of increasing output of a good or service by a small amount.

Mass curve A graph of the cumulative values of a hydrologic quantity (such as precipitation or runoff), generally as ordinate, plotted against time or date as abscissa. (See Double-mass curve and Residual-mass curve.)

Maximum contaminant level (MCL) The highest level of a contaminant that the US EPA allows in drinking water. MCLs ensure that drinking water does not pose either a short-term or long-term health risk. The US EPA sets MCLs at levels that are economically and technologically feasible. MCLs are enforceable standards. Some states set MCLs which are more strict than the US EPA's.

Maximum contaminant level goal (MCLG) The level of a contaminant at which there would be no risk to human health. This goal is not always economically or technologically feasible, and the goal is not legally enforceable.

Maximum probable flood See Flood, maximum probable.

Meander The winding of a stream channel.

Meander amplitude Distance between points of maximum curvature of successive meanders of opposite phase in a direction normal to the general course of the meander belt, measured between centerlines of channels.

Meander belt Area between lines drawn tangential to the extreme limits of fully developed meanders.

Meander breadth The distance between the lines used to define the meander belt.

Meander length Distance in the general course of the meanders between corresponding points of successive meanders of the same phase. Twice the distance between successive points of inflection of the meander wave.

Meandering stream One that follows its natural course, creating winding curves.

Medical waste Any solid waste generated in the diagnosis, treatment, or immunization of human beings or animals; in research pertaining thereto; or in the production or testing of biologicals, excluding hazardous waste identified or listed under 40 CFR Part 261 or any household waste as defined in 40 CFR Subsection 261.4(b)(1).

Meromictic lake A lake in which some water remains partly or wholly unmixed with the main water mass at circulation periods is said to be meromictic. The process leading to a meromictic state is termed meromixis. The perennially stagnant deep layer of a meromictic lake is called the monimolimnion. The part of a meromictic lake in which free circulation can occur is called the

mixolimnion. The boundary between the monimolimnion and the mixolimnion is called the chemocline.

Mesotrophic The term describes reservoirs and lakes that contain moderate quantities of nutrients and are moderately productive in terms of aquatic animal and plant life.

Metal mining sector Metal mining facilities that fall within Standard Industrial Classification Code 10 and must report to the Toxics Release Inventory in accordance with Section 313 of the Emergency Planning and Community Right-to-Know Act.

Microorganisms Tiny living organisms that can be seen only with the aid of a microscope. Some microorganisms can cause acute health problems when consumed in drinking water. Also known as microbes.

Mineralization Most nitrogen exists in biosolids/manure as organic-N, principally contained in proteins, nucleic acids, amines, and other cellular material. These complex molecules must be broken apart through biological degradation for nitrogen to become available to crops. The conversion of organic-N to inorganic-N forms is called mineralization.

Mining water use Water use during quarrying rocks and extracting minerals from the land.

Mobile source A term used to describe a wide variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place. "On-road" sources are vehicles used on roads to transport passengers or freight. "Nonroad" sources include vehicles, engines, and equipment used for construction, agriculture, transportation, recreation, and many other purposes.

Moisture Water diffused in the atmosphere or the ground.

Moisture equivalent The ratio of (1) the weight of water which the soil, after saturation, will retain against a centrifugal force 1,000 times the force of gravity to (2) the weight of the soil when dry. The ratio is stated as a percentage.

Monitoring Testing that water systems must perform to detect and measure contaminants. A water system that does not follow the US EPA's monitoring methodology or schedule is in violation and may be subject to legal action.

Mudflow A well-mixed mass of water and alluvium which, because of its high viscosity and low fluidity as compared with water, moves at a much slower rate, usually piling up and spreading over the fan like a sheet of wet mortar or concrete.

Municipal solid waste Waste from homes, institutions, and commercial sources consisting of everyday items such as product packaging, grass clippings, furniture, clothing, bottles and cans, food scraps, newspapers, appliances, consumer electronics, and batteries. (Excluded from this category are municipal wastewater-treatment sludge, industrial process wastes, automobile bodies, combustion ash, and construction and demolition debris.)

Municipal water system A water system that has at least five service connections or which regularly serves 25 individuals for 60 days, also called a public water system.

Narrative criteria Nonnumeric descriptions of desirable or undesirable water quality conditions.

National ambient air quality standards (NAAQS) Standards established by the US EPA that apply to outdoor air throughout the country. The Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The US EPA has set NAAQS for the six criteria pollutants.

National indicator An ROE indicator for which nationally consistent data are available and which helps to answer an ROE question at a national scale. Some national indicators also present data broken down by US EPA region. (See ROE indicator.)

National pollutant discharge elimination system (NPDES) permit The regulatory agency document issued by either a federal or state agency that is designed to control all discharges of pollutants from point sources into US waterways. The NPDES permits regulate discharges into navigable waters from all point sources of pollution, including industries, municipal water and wastewater-treatment plants, power plants, sanitary landfills, large agricultural feedlots, and return irrigation flows.

National priorities list (NPL) The US EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. (See Superfund.)

National Water Quality Inventory A report the US EPA prepares every 2 years summarizing information from states about the quality of the nation's waters.

Natural source A term used in this report to describe any air emission source of natural origin. Examples include volcanoes, wild fires, windblown dust, and releases due to biological processes (see Biogenic source).

Nephelometric turbidity unit (NTU) Unit of measure for the turbidity of water. Essentially, a measure of the cloudiness of water as measured by a nephelometer. Turbidity is based on the amount of light that is reflected off particles in the water.

NGVD National Geodetic Vertical Datum. (1) As corrected in 1929, a vertical control measure used as a reference for establishing varying elevations. (2) Elevation datum plane previously used by the Federal Emergency Management Agency (FEMA) for the determination of flood elevations. FEMA currently uses the North American Vertical Datum Plane.

NGVD of 1929 National Geodetic Vertical Datum of 1929. A geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada. It was formerly called "Sea Level Datum of 1929" or "mean sea level" in the USGS series of reports. Although the datum was derived from the average sea level over a period of many years at 26 tide stations along the Atlantic, Gulf of Mexico, and Pacific Coasts, it does not necessarily represent local mean sea level at any particular place.

Nitrogen Nutrient that is essential to plants and animals.

Nonindigenous species A species that has been introduced by human action, either intentionally or by accident, into an area outside its natural geographic range, also called an alien, exotic, introduced, or nonnative species. Certain nonindigenous species are considered "invasive." (See Invasive species.)

Nonpoint source Diffuse pollution source; a source without a single point of origin or not introduced into a receiving stream from a specific outlet. The pollutants are generally carried off the land by rainfall or snowmelt moving over and through the ground and carrying natural and human-made contaminants into lakes, rivers, streams, wetlands, estuaries, other coastal waters, and groundwater. Common nonpoint sources are agriculture, forestry, urban areas, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.

Nonpoint-source (NPS) pollution Pollution discharged over a wide land area, not from one specific location. These are forms of diffuse pollution caused by sediments, nutrients, and organic and toxic substances originating from land-use activities, which are carried to lakes and streams by surface runoff. Nonpoint-source pollution is contamination that occurs when rainwater, snowmelt, or irrigation washes off plowed fields, city streets, or suburban backyards. As this runoff moves across the land surface, it picks up soil particles and pollutants, such as nutrients and pesticides.

Nonproduction-related waste Waste that is not production related, for example, waste associated with catastrophic events and cleanup actions. Toxic chemicals in nonproduction-related waste must be reported to the Toxics Release Inventory (see Toxics Release Inventory).

Nonpublic water system A water system that does not provide water for human consumption through at least 15 service connections, or regularly serve at least 25 individuals, for at least 60 days per year.

Non-transient noncommunity water system A type of public water system that supplies water to 25 or more of the same people at least 6 months per year in places other than their residences. Some examples are schools, factories, office buildings, and hospitals that have their own water systems. (See Public water system.)

Normal A central value (such as arithmetic average or median) of annual quantities for a 30-year period ending with an even 10-year, thus 1921–1950, 1931–1960, and so forth. This definition accords with that recommended by the Subcommittee on Hydrology of the Federal Interagency Committee on Water Resources.

Numeric criteria Numeric descriptions of desirable or undesirable water quality conditions.

Nutrients (1) Nutrients are elements required for plant growth that provide biosolids with most of their economic value. These include nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), sulfur (S), boron (B), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), and zinc (Zn). (2) Any substance assimilated by living things that promotes growth. (3) Substances necessary for the growth of all living things, such as nitrogen, carbon, potassium, and phosphorus. Too many nutrients in waterbodies can contribute to algal blooms. The term is generally applied to nitrogen and phosphorus but is also applied to other essential and trace elements.

Oil and gas production waste Gas and oil drilling mud, oil production brines, and other wastes associated with exploration for, or development and production of, crude oil or natural gas.

On-site treatment See Treatment.

Open channel flow Flow of water or a liquid with its surface exposed to the atmosphere. The conduit may be an open channel or a closed conduit flowing partly full.

Organic contaminants Carbon-based chemicals, such as solvents and pesticides, which can get into water through runoff from cropland or discharge from factories. The US EPA has set legal limits on 56 organic contaminants.

Organic matter Plant and animal residues or substances made by living organisms. All are based upon carbon compounds.

Osmosis The movement of water molecules through a thin membrane. The osmosis process occurs in our bodies and is also one method of desalinating saline water.

Outfall The place where a sewer, drain, or stream discharges; the outlet or structure through which reclaimed water or treated effluent is finally discharged to a receiving waterbody.

Overland flow The flow of rainwater or snowmelt over the land surface toward stream channels. After it enters a stream, it becomes runoff.

Oxygen demand The need for molecular oxygen to meet the needs of biological and chemical processes in water. Even though very little oxygen will dissolve in water, it is extremely important in biological and chemical processes.

Ozone depletion Destruction of the stratospheric ozone layer, which shields the Earth from ultraviolet radiation harmful to life. This destruction of ozone is caused by the breakdown of certain chlorine- and/or bromine-containing compounds (chlorofluorocarbons or halons). These compounds break down when they reach the stratosphere and then catalytically destroy ozone molecules.

Ozone-depleting substance Any compound that contributes to stratospheric ozone depletion (see Ozone depletion).

Partial-duration flood series A list of all flood peaks that exceed a chosen base stage or discharge, regardless of the number of peaks occurring in a year. (Also called basic-stage flood series or floods above a base.)

Particle size The diameter, in millimeters, of suspended sediment or bed material. Particle-size classifications are (1) clay = 0.00024–0.004 mm, (2) silt = 0.004–0.062 mm, (3) sand = 0.062–2.0 mm, and (4) gravel = 2.0–64.0 mm.

Particulates Small pieces of material (such as sand) floating in the water.

Pasture Land on which animals feed directly on feed crops such as legumes, grasses, or grain stubble.

Pathogen (1) A disease-causing organism or (2) a disease-producing agent, usually applied to a living organism. Generally, any viruses, bacteria, or fungi that cause disease.

Peak flow The maximum instantaneous discharge of a stream or river at a given location. It usually occurs at or near the time of maximum stage.

Per capita use The average amount of water used per person during a standard time period, generally per day.

Percolation (1) The movement of water through the openings in rock or soil; (2) the entrance of a portion of the streamflow into the channel materials to contribute to groundwater replenishment; (3) the movement, under hydrostatic pressure, of water through the interstices of a rock or soil, except the movement through large openings such as caves.

Percolation, deep In irrigation or farming practice, the amount of water that passes below the root zone of the crop or vegetation.

Permeability The ability of a material to allow the passage of a liquid, such as water through rocks. Permeable materials, such as gravel and sand, allow water to move quickly through them, whereas unpermeable material, such as clay, don't allow water to flow freely.

Pervious surface A surface which allows water to soak into it.

pH (1) A measure of the degree of acidity or alkalinity of a substance. (2) A symbol for expressing the degree to which a solution is acidic or basic. It is based on a scale from 0 (very acid) to 14 (very basic). Water with a pH of 7 is neutral; lower pH levels indicate increasing acidity, while pH levels higher than 7 indicate increasingly basic solutions. The pH of biosolids is often raised with alkaline materials to reduce pathogen content and attraction of disease-spreading organisms (vectors). High pH (greater than 11) kills virtually all pathogens and reduces the solubility, biological availability, and mobility of most metals. Lime also increases the gaseous loss (volatilization) of the ammonia form of nitrogen (ammonia-N), thus reducing the N-fertilizer value of biosolids.

Phosphorus A nutrient that is essential to plants and animals.

Photosynthesis The conversion of light energy to chemical energy. At night, this process reverses: plants and algae suck oxygen out of the water.

Plant available nitrogen (PAN) Only a portion of the total nitrogen present in biosolids/manure is available for plant uptake. This plant available nitrogen (PAN) is the actual amount of N in the biosolids/manure that is available to crops during a specified period.

Planting and harvesting periods The cycle of crop planting and harvesting periods, not the calendar year, dictates the timing of biosolids and manure land application activities. Winter wheat and perennial forage grasses are examples of crops that may be established and harvested in different calendar years.

Planting season The basic time management unit is often called the crop year or planting season. The crop year is defined as the year in which a crop receiving the biosolids/manure treatment is harvested.

Point source A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution, such as a pipe, ditch, ship, ore pit, or factory smokestack.

Point-source pollution Water pollution coming from a single point, such as a sewage-outflow pipe.

Pollutant (1) A contaminant in a concentration or amount that adversely alters the physical, chemical, or biological properties of the natural environment. (2) Any substance introduced into the environment that may adversely affect the usefulness of a resource or the health of humans, animals, or ecosystems. For most environmental media, this term is commonly understood to refer to substances introduced by human activities. In the case of air, the convention is to include substances emitted from natural sources as well (see Air pollutant).

Pollutant concentration limits (PCL) Pollutant concentration limits are the maximum concentrations of heavy metals for biosolids whose trace element pollutant additions do not require tracking (i.e., calculation of CPLR (cumulative pollutant loading rate)). PCL are the most stringent pollutant limits included in US Federal Regulation Part 503 for land application. Biosolids meeting pollutant concentration limits are subject to fewer requirements than biosolids meeting ceiling concentration limits.

Polychlorinated biphenyls (PCBs) A group of synthetic, toxic industrial chemical compounds once used in making paint and electrical transformers, which are chemically inert and not biodegradable. PCBs were frequently found in industrial wastes, and subsequently found their way into surface and groundwaters. As a result of their persistence, they tend to accumulate in the environment. In terms of streams and rivers, PCBs are drawn to sediment, to which they attach and can remain virtually indefinitely. Although virtually banned in 1979 with the passage of the Toxic Substances Control Act, they continue to appear in the flesh of fish and other animals.

Pondage Small-scale storage at a waterpower plant to equalize daily or weekly fluctuations in riverflow or to permit irregular hourly use of the water for power generation to accord with fluctuations in load.

Pool (1) A deep reach of a stream. (2) In streams, a relatively deep area with low velocity; in ecological systems, the supply of an element or compound, such as exchangeable or weatherable cations or adsorbed sulfate, in a defined component of the ecosystem. The reach of a stream between two riffles. Natural streams often consist of a succession of pools and riffles.

Pool-riffle ratio The ratio of stream surface area covering pools to stream surface area covering riffles in a given segment of stream.

Population In ecology, a group of interbreeding organisms occupying a particular space. In other contexts, including human health, this term generally refers to the number of humans living in a designated area.

Porosity A measure of the water-bearing capacity of subsurface rock. With respect to water movement, it is not just the total magnitude of porosity that is important, but the size of the voids and the extent to which they are interconnected, as the pores in a formation may be open, or interconnected, or closed and isolated. For example, clay may have a very high porosity with respect to potential water content, but it constitutes a poor medium as an aquifer because the pores are usually so small.

Potable water Water of a quality suitable for drinking.

Potential evapotranspiration Water loss that will occur if at no time there is a deficiency of water in the soil for use of vegetation.

Potential natural water loss The water loss during years when the annual precipitation greatly exceeds the average water loss. It represents the approximate upper limit to water loss under the type and density of vegetation native to a basin, actual conditions of moisture supply, and other basin characteristics, whereas potential evapotranspiration represents the hypothetical condition of no deficiency of water in the soil at any time for use of the type and density of vegetation that would develop.

Potential rate of evaporation See Evaporativity.

Precipitation (1) Precipitation includes rain, snow, hail, sleet, dew, and frost. (2) As used in hydrology, precipitation is the discharge of water, in liquid or solid state, out of the atmosphere, generally upon a land or water surface. It is the common process by which atmospheric water becomes surface or subsurface water. The term "precipitation" is also commonly used to designate the quantity of water that is precipitated. Precipitation includes rainfall, snow, hail, and sleet and is therefore a more general term than rainfall.

Precursor In photochemistry, any compound antecedent to a pollutant. For example, volatile organic compounds (VOCs) and nitrogen oxides react in sunlight to form ozone or other photochemical oxidants. As such, VOCs and nitrogen oxides are precursors.

Preparer Either the person who generates sewage sludge during the treatment of domestic sewage in a treatment work or the person who derives a material from sewage sludge.

Primacy state A state that has the responsibility and authority to administer the US EPA's drinking water regulations within its borders. The state must have rules at least as stringent as the US EPA's.

Primary pollutant Any pollutant that is emitted into the atmosphere directly from its source and that retains the same chemical form. An example of a primary pollutant is dust that blows into the air from a landfill.

Primary wastewater treatment The first stage of the wastewater-treatment process where mechanical methods, such as filters and scrapers, are used to remove pollutants. Solid material in sewage also settles out in this process.

Prior appropriation doctrine The system for allocating water to private individuals used in most Western states. The doctrine of prior appropriation was in common use throughout the arid West as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of "First in Time, First in Right." The first person to take a quantity of water and put it to beneficial use has a higher priority of right than a subsequent user. The rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrasts with riparian water rights.

Priority chemicals A set of chemicals, found in the nation's products and wastes, that US EPA targets for voluntary reduction (or recovery and recycling if they cannot be eliminated or reduced at the source).

Production-related waste The sum of a facility's production-related on-site waste releases, on-site waste management (recycling, treatment, and combustion for energy recovery), and off-site transfers for disposal, treatment, recycling, or energy recovery. Toxic chemicals in production-related waste must be reported to the Toxics Release Inventory (see Toxics Release Inventory).

Public contact site Land with a high potential for contact by the public, including public parks, ball fields, cemeteries, nurseries, turf farms, and golf courses.

Public notification An advisory that the US EPA requires a water system to distribute to affected consumers when the system has violated MCLs or other regulations. The notice advises consumers what precautions, if any, they should take to protect their health.

Public supply Water withdrawn by public governments and agencies, such as a county water department, and by private companies that is then delivered to users. Public suppliers provide

water for domestic, commercial, thermoelectric power, industrial, and public water users. Most people's household water is delivered by a public water supplier. The systems have at least 15 service connections (such as households, businesses, or schools) or regularly serve at least 25 individuals daily for at least 60 days out of the year.

Public water system (PWS) A system that provides water for human consumption through at least 15 service connections, or regularly serves at least 25 individuals, for at least 60 days per year. Public water systems are divided into three categories (see Community water system, Non-transient noncommunity water system, and Transient noncommunity water system). Examples of public water systems include municipal water companies, homeowner associations, schools, businesses, campgrounds, and shopping malls. There are more than 170,000 PWSs providing water from wells, rivers and other sources to about 250 million Americans.

Public water use Water supplied from a public water supply and used for such purposes as firefighting, street washing, and municipal parks and swimming pools.

Radioactive waste Waste containing substances that emit ionizing radiation. Radioactive waste is classified by regulation according to its source and/or content. The types of waste that are typically considered "radioactive waste" include high-level waste, low-level waste, mixed low-level waste, transuranic waste (i.e., elements heavier than uranium), and certain wastes from the extraction and processing of uranium or thorium ore. Spent nuclear fuel, which is produced as a result of the controlled nuclear fission process in nuclear reactors, is considered a nuclear material rather than radioactive waste.

Radionuclides Any man-made or natural element that emits radiation and that may cause cancer after many years of exposure through drinking water.

Rain Liquid precipitation.

Rainfall The quantity of water that falls as rain only. Not synonymous with precipitation.

Rainfall excess The volume of rainfall available for direct runoff. It is equal to the total rainfall minus interception, depression storage, and absorption.

Rainfall, excessive Rainfall in which the rate of fall is greater than certain adopted limits, chosen with regard to the normal precipitation (excluding snow) of a given place or area. In the US Weather Bureau, it is defined, for states along the southern Atlantic coast and the Gulf coast, as rainfall in which the depth of precipitation is 0.90 in. at the end of 30 min and 1.50 in. at the end of an hour and, for the rest of the country, as rainfall in which the depth of precipitation at the end of each of the same periods is 0.50 in. and 0.80 in., respectively.

Rangeland Open land with indigenous vegetation.

Rating curve A drawn curve showing the relation between gage height and discharge of a stream at a given gaging station.

Raw water Water in its natural state, prior to any treatment for drinking.

RCRA cleanup baseline A priority subset of the universe of facilities that are subject to cleanup under the Resource Conservation and Recovery Act (RCRA) due to past or current treatment, storage, or disposal of hazardous wastes and that have historical releases of contamination.

RCRA hazardous waste A national regulatory designation for certain wastes under the Resource Conservation and Recovery Act (RCRA). Some wastes are given this designation because they are specifically listed on one of four RCRA hazardous waste lists (see http://www.epa.gov/epaoswer/osw/hazwaste.htm). Other wastes receive this designation because they exhibit at least one of four characteristics which are ignitability, corrosivity, reactivity, or toxicity.

Reach (1) The length of channel uniform with respect to discharge, depth, area, and slope. (2) The length of a channel for which a single gage affords a satisfactory measure of the stage and discharge. (3) The length of a river between two gaging stations. (4) More generally, any length of a river.

Reaeration The rate at which oxygen is absorbed back into water. This is dependent, among other things, upon turbulence intensity and the water depth.

Receiving waters A river, lake, ocean, stream, or other bodies of water into which wastewater or treated effluent is discharged.

Recession curve A hydrograph showing the decreasing rate of runoff following a period of rain or snowmelt. Since direct runoff and base runoff recede at different rates, separate curves, called direct runoff recession curves or base runoff recession curves, are generally drawn. The term "depletion curve" in the sense of base runoff recession is not recommended.

Recharge Water added to an aquifer. For instance, rainfall that seeps into the ground.

Reclaimed wastewater Treated wastewater that can be used for beneficial purposes, such as irrigating certain plants.

Reclamation site Drastically disturbed land, such as strip mines and construction sites, that is reclaimed using sewage sludge.

Recurrence interval (return period) The average interval of time within which the given flood will be equaled or exceeded once.

Recycled water Water that is used more than one time before it passes back into the natural hydrologic system.

Regime "Regime theory" is a theory of the forming of channels in material carried by the streams. As used in this sense, the word "regime" applies only to streams that make at least part of their boundaries from their transported load and part of their transported load from their boundaries, carrying out the process at different places and times in any one stream in a balanced or alternating manner that prevents unlimited growth or removal of boundaries. A stream, river, or canal of this type is called a "regime stream, river, or canal." A regime channel is said to be "in regime" when it has achieved average equilibrium; that is, the average values of the quantities that constitute regime do not show a definite trend over a considerable period—generally of the order of a decade. In unspecialized use "regime" and "regimen" are synonyms. Regimen of a stream. The system or order characteristic of a stream; in other words, its habits with respect to velocity and volume, form of and changes in channel, capacity to transport sediment, and amount of material supplied for transportation. The term is also applied to a stream which has reached an equilibrium between corrosion and deposition or, in other words, to a graded stream.

Regional indicator An ROE indicator that helps to answer an ROE question on a smaller-than-national geographic scale. A regional indicator may cover a topic for which nationally consistent data are unavailable, or it may present an issue that is of particular concern within a certain geographic area. (See ROE indicator.)

Regulation The artificial manipulation of the flow of a stream.

Remedial action The actual construction or cleanup phase of a site cleanup.

Remote sensing (1) The analysis and interpretation of images gathered through techniques that do not require direct contact with the subject. (2) A discipline that evolved from photogrammetry, remote sensing of the Earth's resources uses aerial or space photographs, electronic scanners, and other devices to collect data about the Earth's surface and subsurface.

Report on the environment (ROE) A US EPA report which presents the best available indicators of information on national conditions and trends in air, water, land, human health, and ecological

systems that address all questions US EPA considers mission critical to protecting our environment and human health.

Reregulating reservoirs A reservoir for reducing diurnal fluctuations resulting from the operation of an upstream reservoir for power production.

Reservoir A pond, lake, or basin, either natural or artificial, for the storage, regulation, and control of water.

Residual-mass curve A graph of the cumulative departures from a given reference such as the arithmetic average, generally as ordinate, plotted against time or date, as abscissa. (See Mass curve.)

Respiration The biological oxidation of organic carbon with concomitant reduction of external oxidant and the production of energy. In aerobic respiration, O_2 is reduced to CO_2. Anaerobic respiration processes utilize NO_3^- (denitrification), SO_4^{2-} (sulfate reduction), or CO_2 (methanogenesis).

Restoration An activity returning a wetland from a disturbed or altered condition with lesser acreage or functions to a previous condition with greater wetland acreage or functions. For example, restoration might involve the plugging of a drainage ditch to restore the hydrology to an area that was a wetland before the installation of the drainage ditch.

Retarding reservoir Ungated reservoir for temporary storage of floodwater. Sometimes called detention reservoir.

Return flow (1) That part of a diverted flow that is not consumptively used and returned to its original source or another body of water. (2) (Irrigation) Drainage water from irrigated farmlands that reenters the water system to be used further downstream.

Return flow (irrigation) (1) Irrigation water that is applied to an area and which is not consumed in evaporation or transpiration and returns to a surface stream or aquifer; (2) that part of irrigation water that is not consumed by evapotranspiration and that returns to its source or another body of water. The term is also applied to the water that is discharged from industrial plants. Also called return water.

Reverse osmosis (1) (Desalination) The process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed and disposed. This process differs from electrodialysis, where the salts are extracted from the feedwater by using a membrane with an electrical current to separate the ions. The positive ions go through one membrane, while the negative ions flow through a different membrane, leaving the end product of freshwater. (2) (Water quality) An advanced method of water or wastewater treatment that relies on a semipermeable membrane to separate waters from pollutants. An external force is used to reverse the normal osmotic process resulting in the solvent moving from a solution of higher concentration to one of lower concentration.

Riffle (1) A rapid in a stream; (2) a shallow section in a stream where water is breaking over rocks or other partially submerged organic debris and producing surface agitation.

Riparian (1) Areas next to or substantially influenced by water; (2) pertaining to the banks of a stream. These may include areas adjacent to rivers, lakes, or estuaries. These areas often include wetlands.

Riparian water rights The rights of an owner whose land abuts water. They differ from state to state and often depend on whether the water is a river, lake, or ocean. The doctrine of riparian rights is an old one, having its origins in English common law. Specifically, persons who own land adjacent to a stream have the right to make reasonable use of the stream. Riparian users of a stream share the

streamflow among themselves, and the concept of priority of use (prior appropriation doctrine) is not applicable. Riparian rights cannot be sold or transferred for use on non-riparian land.

Risk A measure of the chance that damage to life, health, property, or the environment will occur.

Risk assessment A methodology used to examine all possible risks involved with a particular product or organism. Risk assessment can be divided into four parts: identification of hazards, dose response (how much exposure causes particular problems such as cancer, convulsions, and death), exposure assessment (determining how much exposure will be received by people during particular activities), and risk characterization (determining a probability that a risk will occur).

Risk factor A characteristic (e.g., race, sex, age, obesity) or variable (e.g., smoking, occupational exposure level) associated with increased probability of an adverse effect.

River A natural stream of water of considerable volume, larger than a brook or creek.

River morphology Study of the evolution and configuration of river.

ROE See Report on the Environment.

ROE indicator An indicator that meets the ROE criteria and has been peer reviewed. (See Indicator.)

Runoff That part of the precipitation, such as snowmelt, or irrigation water that appears in uncontrolled surface streams, drains, or sewers. It is the same as streamflow unaffected by artificial diversions, storage, or other works of man in or on the stream channels. Runoff may be classified as follows: (1) classification as to speed of appearance after rainfall or snowmelting, direct runoff or base runoff, and (2) classification as to source, surface runoff (see Overland flow), storm seepage (storm inter), or groundwater runoff (see Stream, gaining). It can collect pollutants from air or land and carry them to streams and other waterbodies. Also defined as the depth to which a drainage area would be covered if all of the runoff for a given period of time were uniformly distributed over it.

Runout See Water yield.

Saline water Water that contains significant amounts of dissolved solids. Here are our parameters for saline water: freshwater, less than 1,000 ppm; slightly saline water, from 1,000 to 3,000 ppm; moderately saline water, from 3,000 to 10,000 ppm; and highly saline water, from 10,000 to 35,000 ppm Note: 1ppm=1 mg/L.

Sample The water that is analyzed for the presence of the US EPA-regulated drinking water contaminants. Depending on the regulation, the US EPA requires water systems and states to take samples from source water, from water leaving the treatment facility, or from the taps of selected consumers.

Sanitary survey An on-site review of the water sources, facilities, equipment, operation, and maintenance of a public water systems for the purpose of evaluating the adequacy of the facilities for producing and distributing safe drinking water.

Secchi disk A black-and-white disk used to measure the clarity of water. The disk is lowered into the water until it cannot be seen and then the depth of the disk is measured.

Secondary Drinking Water Standards Non-enforceable federal guidelines regarding cosmetic effects (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water.

Secondary pollutant Any pollutant that is formed by atmospheric reactions of precursor or primary emissions. An example of a secondary pollutant is ground-level ozone, which forms from chemical reactions involving airborne nitrogen oxides, airborne volatile organic compounds, and sunlight.

Secondary wastewater treatment Treatment (following primary wastewater treatment) involving the biological process of reducing suspended, colloidal, and dissolved organic matter in effluent from primary treatment systems and which generally removes 80–95 % of the Biochemical Oxygen Demand (BOD) and suspended matter. Secondary wastewater treatment may be accomplished by

biological or chemical-physical methods. Activated sludge and trickling filters are two of the most common means of secondary treatment. It is accomplished by bringing together waste, bacteria, and oxygen in trickling filters or in the activated sludge process. This treatment removes floating and settleable solids and about 90 % of the oxygen-demanding substances and suspended solids. Disinfection is the final stage of secondary treatment.

Second-foot Same as cfs, or cubic foot per second. This term is no longer used in published reports of the US Geological Survey.

Sediment (1) Fragmental material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air or is accumulated in beds by other natural agencies. (2) Usually applied to material in suspension in water or recently deposited from suspension. In its plural form the word is applied to all kinds of deposits from the waters of streams, lakes, or seas.

Sediment discharge The rate at which dry weight of sediment passes a section of a stream or refers to the quantity of sediment, as measured by dry weight or by volume, that is discharged in a given time.

Sedimentary rock Rock formed of sediment and specifically (1) sandstone and shale formed of fragments of other rock transported from their sources and deposited in water and (2) rocks formed by or from secretions of organisms, such as most limestone. Many sedimentary rocks show distinct layering, which is the result of different types of sediments being deposited in succession.

Sedimentation tanks or basins Wastewater tanks/basins in which floating scums are skimmed off and settled solids are removed for disposal.

Seepage (1) The slow movement of water through small cracks, pores, interstices, etc., of a material into or out of a body of surface or subsurface water. (2) The loss of water by infiltration into the soil from a canal, ditches, laterals, watercourse, reservoir, storage facilities, or other bodies of water or from a field.

Seiche The free oscillation of the bulk of water in a lake and the motion caused by it on the surface of the lake.

Self-supplied water Water withdrawn from a surface- or groundwater source by a user rather than being obtained from a public supply. An example would be homeowners getting their water from their own well.

Septage Septage means the liquid and solid materials pumped from a septic tank, cesspool, or similar domestic sewage treatment system or holding tank when the system is cleaned or maintained.

Septic system A system that treats and disposes of household wastewater under the ground.

Septic tank A tank used to detain domestic wastes to allow the settling of solids prior to distribution to a leach field for soil absorption. Septic tanks are used when a sewer line is not available to carry them to a treatment plant. A settling tank in which settled sludge is in immediate contact with sewage flowing through the tank, and wherein solids are decomposed by anaerobic bacterial action.

Settling pond (water quality) An open lagoon into which wastewater contaminated with solid pollutants is placed and allowed to stand. The solid pollutants suspended in the water sink to the bottom of the lagoon and the liquid is allowed to overflow out of the enclosure.

Sewage sludge The solid, semisolid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage, scum, and solids removed during primary, secondary, or advanced wastewater-treatment processes. The definition of sewage sludge also includes a material derived from sewage sludge (i.e., sewage sludge whose quality is changed either through further treatment or through mixing with other materials).

Sewage sludge A semisolid residue from any of a number of air- or water-treatment processes. When treated and processed, sewage sludge becomes a nutrient-rich organic material called biosolids.

Sewage treatment plant A facility designed to receive the wastewater from domestic sources and to remove materials that damage water quality and threaten public health and safety when discharged into receiving streams or bodies of water. The substances removed are classified into four basic areas: (1) greases and fats, (2) solids from human waste and other sources, (3) dissolved pollutants from human waste and decomposition products, and (4) dangerous microorganisms. Most facilities employ a combination of mechanical removal steps and bacterial decomposition to achieve the desired results. Chlorine is often added to discharges from the plants to reduce the danger of spreading disease by the release of pathogenic bacteria.

Sewer A system of underground pipes that collect and deliver wastewater to treatment facilities or streams.

Shifting control See Control.

Sinkhole A depression in the Earth's surface caused by dissolving of underlying limestone, salt, or gypsum. Drainage is provided through underground channels that may be enlarged by the collapse of a cavern roof.

Site characterization A location-specific or area-specific survey conducted to characterize physical, chemical, and/or biological attributes of an area; such surveys may be conducted at different times to provide information on how these attributes may change over time.

Skimming The diversion of water from a stream or conduit by a shallow overflow used to avoid diversion of sand, silt, or other debris carried as bottom load.

Snow A form of precipitation composed of ice crystals.

Snow course A line or series of connecting lines along which snow samples are taken at regularly spaced points.

Snow density Ratio between the volume of meltwater derived from a sample of snow and the initial volume of the sample. This is numerically equal to the specific gravity of the snow.

Snow, quality of The ratio of heat of melting of snow, in calories per gram to the 80 cal per gram for melting pure ice at 0 °C. Percentage by weight which is ice.

Snowline The general altitude to which the continuous snow cover of high mountains retreats in summer, chiefly controlled by the depth of the winter snowfall and by the temperature of the summer.

Snowline, temporary A line sometimes drawn on a weather map during the winter showing the southern limit of the snow cover.

Soil moisture (soil water) Water diffused in the soil, the upper part of the zone of aeration from which water is discharged by the transpiration of plants or by soil evaporation. See Field-moisture capacity and Field-moisture deficiency.

Sole source aquifer An aquifer that supplies 50 % or more of the drinking water of an area.

Solubility The ability of a chemical (e.g., pollutant) to be dissolved into a solvent (e.g., water column).

Solute A substance that is dissolved in another substance, thus forming a solution.

Solution A mixture of a solvent and a solute. In some solutions, such as sugar water, the substances mix so thoroughly that the solute cannot be seen. But in other solutions, such as water mixed with dye, the solution is visibly changed.

Solvent A substance that dissolves other substances, thus forming a solution. Water dissolves more substances than any other and is known as the "universal solvent."

Source water Water in its natural state, prior to any treatment for drinking.

Specific conductance A measure of the ability of water to conduct an electrical current as measured using a 1 cm cell and expressed in units of electrical conductance, i.e., Siemens per centimeter at 25 °C.

Specific conductance can be used for approximating the total dissolved solids content of water by testing its capacity to carry an electrical current. In water quality, specific conductance is used in groundwater monitoring as an indication of the presence of ions of chemical substances that may have been released by a leaking landfill or other waste storage or disposal facility. A higher specific conductance in water drawn from downgradient wells when compared to upgradient wells indicates possible contamination from the facility.

Spray irrigation (1) A method of land application by which wastewater is sprayed from nozzles onto land. (2) A common irrigation method where water is shot from high-pressure sprayers onto crops. Because water is shot high into the air onto crops, some water is lost to evaporation.

Spring A waterbody formed when the side of a hill, a valley bottom, or another excavation intersects a flowing body of groundwater at or below the local water table, below which the subsurface material is saturated with water.

Stage The height of a water surface above an established datum plane, also gage height.

Stage, flood See Flood stage.

Stage–capacity curve A graph showing the relation between the surface elevation of the water in a reservoir, usually plotted as ordinate, against the volume below that elevation, plotted as abscissa.

Stage–discharge curve (rating curve) A graph showing the relation between the gage height, usually plotted as ordinate, and the amount of water flowing in a channel, expressed as volume per unit of time, plotted as abscissa.

Stage–discharge relation The relation expressed by the stage–discharge curve.

Stakeholder Individual or organization that has a stake in the outcome of the watershed plan.

Stemflow Rainfall or snowmelt led to the ground down the trunks or stems of plants.

Storage (1) Water artificially impounded in surface or underground reservoirs for future use. The term regulation refers to the action of this storage in modifying streamflow. See also Conservation storage, Total storage, Dead storage, and Usable storage. (2) Water naturally detained in a drainage basin, such as groundwater, channel storage, and depression storage. The term "drainage basin storage" or simply "basin storage" is sometimes used to refer collectively to the amount of water in natural storage in a drainage basin.

Storage ratio The net available storage divided by the mean flow for 1 year.

Storage, bank See Bank storage.

Storage, conservation See Conservation storage.

Storage, dead See Dead storage.

Storage, depression See Depression storage.

Storage, total See Total storage.

Storage, usable See Usable Storage.

Storage–required frequency curve A graph showing the frequency with which storage equal to or greater than selected amounts will be required to maintain selected rates of regulated flow.

Storm A disturbance of the ordinary average conditions of the atmosphere which, unless specifically qualified, may include any or all meteorologic disturbances, such as wind, rain, snow, hail, or thunder.

Storm seepage That part of precipitation which infiltrates the surface soil and moves toward the streams as ephemeral, shallow, perched groundwater above the main groundwater level. Storm seepage is usually part of the direct runoff.

Storm sewer A sewer that carries only surface runoff, street wash, and snowmelt from the land. In a separate sewer system, storm sewers are completely separate from those that carry domestic and commercial wastewater (sanitary sewers).

Stormflow See Direct runoff.

Stratosphere The layer of the atmosphere that starts about 6–9 miles above the Earth's surface at midlatitudes and lies atop the troposphere. The stratosphere contains small amounts of gaseous ozone, which filters out about 99 % of the incoming ultraviolet radiation.

Stream A general term for a body of flowing water and natural water course containing water at least part of the year. In hydrology the term is generally applied to the water flowing in a natural channel as distinct from a canal. More generally as in the term stream gaging, it is applied to the water flowing in any channel, natural or artificial. Streams in natural channels may be classified as follows in relation to time: (1) perennial stream, one which flows continuously; (2) intermittent or seasonal stream, one which flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas; and (3) ephemeral stream, one that flows only in direct response to precipitation and whose channel is at all times above the water table. Streams in natural channels may be classified as follows in relation to space: (1) continuous stream, one that does not have interruptions in space and (2) interrupted stream, one which contains alternating reaches that are either perennial, intermittent, or ephemeral. Streams in natural channels may also be classified as follows in relation to groundwater: (1) gaining stream, a stream or reach of a stream that receives water from the zone of saturation; (2) losing stream, a stream or reach of a stream that contributes water to the zone of saturation; (3) insulated stream, a stream or reach of a stream that neither contributes water to the zone of saturation nor receives water from it—it is separated from the zones of saturation by an impermeable bed; and (4) perched stream, a perched stream is either a losing stream or an insulated stream that is separated from the underlying groundwater by a zone of aeration.

Stream gaging The process and art of measuring the depths, areas, velocities, and rates of flow in natural or artificial channels.

Stream meander The length of a stream channel from an upstream point to a downstream point divided by the straight line distance between the same two points.

Stream order A method of numbering streams as part of a drainage basin network. The smallest unbranched mapped tributary is called first order, the stream receiving the tributary is called second order, and so on. It is usually necessary to specify the scale of the map used. A first-order stream on a 1:62,500 map may be a third-order stream on a 1:12,000 map. Tributaries which have no branches are designated as the first order, streams which receive only first-order tributaries are of the second order, larger branches which receive only first-order and second-order tributaries are designated third order, and so on, the main stream being always of the highest order.

Streamflow (1) The water discharge that occurs in a natural channel. (2) A more general term than runoff, streamflow may be applied to discharge whether or not it is affected by diversion or regulation. The discharge that occurs in a natural channel. Although the term discharge can be applied to the flow of a canal, the word streamflow uniquely describes the discharge in a surface stream course.

Streamflow depletion The amount of water that flows into a valley or onto a particular land area minus the water that flows out the valley or off from the particular land area.

Stream-gaging station A gaging station where a record of discharge of a stream is obtained. Within the Geological Survey, this term is used only for those gaging stations where a continuous record of discharge is obtained.

Stressor A physical, chemical, or biological entity that can induce adverse effects on ecosystems or human health.

Submeander Small meander contained with banks of main channel, associated with relatively low discharges.

Subsidence A dropping of the land surface as a result of groundwater being pumped. Cracks and fissures can appear in the land. Subsidence is virtually an irreversible process.

Subsurface runoff See Storm seepage.

Superfund A program, operated under the legislative authority of the Comprehensive Environmental Response, Compensation, and Liability Act and the Superfund Amendments and Reauthorization Act, that funds and carries out the US EPA solid waste emergency and long-term removal and remedial activities. These activities include establishing the National Priorities List, investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising cleanup and other remedial actions. (See National Priorities List.)

Supplemental irrigation Commonly, irrigation as carried on in humid areas. The term means that the irrigation water is supplementary to the natural rainfall rather than being the primary source of moisture as in the arid and semiarid West. Supplementary irrigation is used generally to prevent retardation of growth during periods of drought.

Supplemental sources When irrigation water supplies are obtained from more than one source, the source furnishing the principal supply is commonly designated the primary source, and the sources furnishing the additional supplies, the supplemental sources.

Surface runoff That part of the runoff which travels over the soil surface to the nearest stream channel. It is also defined as that part of the runoff of a drainage basin that has not passed beneath the surface since precipitation. The terms groundwater runoff and surface runoff are classifications according to source. The terms base runoff and direct runoff are time classifications of runoff.

Surface tension The attraction of molecules to each other on a liquid's surface. Thus, a barrier is created between the air and the liquid.

Surface water (1) Water on the surface of the Earth such as in a stream, river, lake, or reservoir. (2) The water that systems pump and treat from sources open to the atmosphere, such as rivers, lakes, and reservoirs.

Suspended sediment Very fine soil particles that remain in suspension in water for a considerable period of time without contact with the bottom. Such material remains in suspension due to the upward components of turbulence and currents and/or by suspension.

Suspended solids Solids that are not in true solution and that can be removed by filtration. Such suspended solids usually contribute directly to turbidity. Defined in waste management, these are small particles of solid pollutants that resist separation by conventional methods.

Suspended-sediment concentration The ratio of the mass of dry sediment in a water-sediment mixture to the mass of the water-sediment mixture. Typically expressed in milligrams of dry sediment per liter of water-sediment mixture.

Suspended-sediment discharge The quantity of suspended sediment passing a point in a stream over a specified period of time. When expressed in tons per day, it is computed by multiplying water discharge (in cubic feet per second) by the suspended-sediment concentration (in milligrams per liter) and by the factor 0.0027.

Terrace A berm or discontinuous segments of a berm, in a valley at some height above the flood plain, representing a former abandoned flood plain of the stream.

Tertiary wastewater treatment Selected biological, physical, and chemical separation processes to remove organic and inorganic substances that resist conventional treatment practices; the additional treatment of effluent beyond that of primary and secondary treatment methods to obtain a very high quality of effluent. The complete wastewater-treatment process typically involves a three-phase

process: (1) First, in the primary wastewater-treatment process, which incorporates physical aspects, untreated water is passed through a series of screens to remove solid wastes; (2) second, in the secondary wastewater-treatment process, typically involving biological and chemical processes, screened wastewater is then passed a series of holding and aeration tanks and ponds; and (3) third, the tertiary wastewater-treatment process consists of flocculation basins, clarifiers, filters, and chlorine basins or ozone or ultraviolet radiation processes.

Thermal pollution A reduction in water quality caused by increasing its temperature often due to disposal of waste heat from industrial or power generation processes. Thermally polluted water can harm the environment because plants and animals can have a hard time adapting to it.

Thermal stratification (of a lake) Vertical temperature stratification that shows the following: the upper layer of the lake, known as the epilimnion, in which the water temperature is virtually uniform; a stratum next below, known as the thermocline, in which there is a marked drop in temperature per unit of depth; and the lowermost region or stratum, known as the hypolimnion, in which the temperature from its upper limit to the bottom is nearly uniform.

Thermocline See Thermal stratification.

Thermoelectric power water use Water used in the process of the generation of thermoelectric power. Power plants that burn coal and oil are examples of thermoelectric-power facilities.

Threatened waterbody A waterbody that is meeting standards but exhibits a declining trend in water quality such that it will likely exceed standards.

Throughfall In a vegetated area, the precipitation that falls directly to the ground or the rainwater or snowmelt that drops from twigs or leaves.

Time of concentration The time required for water to flow from the farthest point on the watershed to the gaging station.

TMDL process The approach normally used to develop a TMDL for a particular waterbody or watershed. This process consists of five activities, including selection of the pollutant to consider, estimation of the waterbody's assimilative capacity, estimation of the pollution from all sources to the waterbody, predictive analysis of pollution in the waterbody and determination of total allowable pollution load, and allocation of the allowable pollution among the different pollution sources in a manner that water quality standards are achieved.

Total Kjeldahl nitrogen (TKN) TKN is the summation of ammonium nitrogen ($NH4^+$-N) and organic nitrogen (organic-N).

Total maximum daily load (TMDL) (1) The amount, or load, of a specific pollutant that a waterbody can assimilate and still meet the water quality standard for its designated use. (2) An estimate of the pollutant concentrations resulting from the pollutant loadings from all sources to a waterbody. The TMDL is used to determine the allowable loads and provides the basis for establishing or modifying controls on pollutant sources. For impaired waterbodies the TMDL reduces the overall load by allocating the load among current pollutant loads (from point and nonpoint sources), background or natural loads, a margin of safety, and sometimes an allocation for future growth.

Total nitrogen It is the summation of ammonium nitrogen (NH_4^+-N), nitrate nitrogen (NO_3^--N), nitrite nitrogen (NO_2^--N), and organic nitrogen (organic-N). Usually nitrite nitrogen is in negligible amount. Crops directly utilize nitrogen in its inorganic forms, principally nitrate-N and ammonium-N.

Total solids (TS) Total solids (TS) include suspended and dissolved solids and are usually expressed as the concentration present in biosolids. TS depend on the type of wastewater process and biosolids' treatment prior to land application. Typical solids contents of various biosolids are liquid (2–12 %), dewatered (12–30 %), and dried or composted (50 %).

Total storage The volume of a reservoir below the maximum controllable level including dead storage.

Toxic chemical A chemical that can produce injury if inhaled, swallowed, or absorbed through the skin.

Toxics release inventory (TRI) A database containing detailed information on nearly 650 chemicals and chemical categories that over 23,000 industrial and other facilities manage through disposal or other releases, recycling, combustion for energy recovery, or treatment.

Toxics release inventory (TRI) chemicals The chemicals and chemical categories that appear on the current TRI toxic chemical list. As of December 2007, the TRI toxic chemical list contains 581 individually listed chemicals and 30 chemical categories (including three delimited categories containing 58 chemicals). The list of TRI chemicals is available at http://www.epa.gov/tri/chemical/index.htm.

Toxics release inventory (TRI) facilities The facilities that are required by Section 313 of the Emergency Planning and Community Right-to-Know Act to report to the TRI. In the 2005 reporting year, approximately 23,500 facilities reported to the TRI.

Trace elements Trace elements are found in low concentrations in biosolids. The trace elements of interest in biosolids are those commonly referred to as "heavy metals."

Transient noncommunity water system A water system which provides water in a place such as a gas station or campground where people do not remain for long periods of time. These systems do not have to test or treat their water for contaminants which pose long-term health risks because fewer than 25 people drink the water over a long period. They still must test their water for microbes and several chemicals.

Transmissibility (groundwater) The capacity of a rock to transmit water under pressure. The coefficient of transmissibility is the rate of flow of water, at the prevailing water temperature, in gallons per day, through a vertical strip of the aquifer 1 ft wide, extending the full saturated height of the aquifer under a hydraulic gradient of 100 %. A hydraulic gradient of 100 % means a 1 ft (0.3048 m) drop in head in 1 ft (0.3048 m) of flow distance.

Transpiration (1) The quantity of water absorbed and transpired and used directly in the building of plant tissue, in a specified time. (2) Process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface, such as leaf pores. (See Evapotranspiration). It does not include soil evaporation. The process by which water vapor escapes from the living plant, principally the leaves, and enters the atmosphere. As considered practically, transpiration also includes guttation.

Treatment Any process that changes the physical, chemical, or biological character of a waste to make it less of an environmental threat. Treatment can neutralize the waste, recover energy or material resources from it, render it less hazardous, or make it safer to transport, store, or dispose of.

Treatment technique (TT) A required process intended to reduce the level of a contaminant in drinking water.

Treatment works Federally owned, publicly owned, or privately owned device or system used to treat (including recycle or reclaim) either domestic sewage or a combination of domestic sewage and industrial waste of a liquid nature.

Treatment works treating domestic sewage A POTW (publicly owned treatment works) or other sewage sludge or wastewater-treatment system or device, regardless of ownership used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated for the disposal of sewage sludge.

Trend A statistical term referring to the direction or rate of increase or decrease in magnitude of the individual members of a time series of data when random fluctuations of individual members are disregarded.

Tributary A smaller river or stream that flows into a larger river or stream. Usually, a number of smaller tributaries merge to form a river.

Trophic state The state of nutrition (e.g., amount of nutrients) in a body of water.

Troposphere The layer of the atmosphere closest to the Earth's surface. The troposphere extends from the surface up to about 6–9 miles.

Turbidity (1) The cloudy appearance of water caused by the presence of tiny particles. High levels of turbidity may interfere with proper water treatment and monitoring. (2) The amount of solid particles that are suspended in water and that cause light rays shining through the water to scatter. Thus, turbidity makes the water cloudy or even opaque in extreme cases. Turbidity is measured in nephelometric turbidity units (NTU). (3) A measure of the degree of clarity of a solution. For cloudy water, turbidity would be high; for clear water, turbidity would be low.

Underflow The downstream flow of water through the permeable deposits that underlie a stream and that are more or less limited by rocks of low permeability.

Underground injection or well injection The technology of placing fluids underground in porous formations of rocks, through wells or other conveyance systems. The fluids may be water, wastewater, or water mixed with chemicals. Regulations for disposing of waste this way vary depending on type of waste. RCRA hazardous waste is placed in highly regulated (Class 1) wells.

Unit hydrograph The hydrograph of direct runoff from a storm uniformly distributed over the drainage basin during a specified unit of time; the hydrograph is reduced in vertical scale to correspond to a volume of runoff of 1 in. from the drainage basin.

Unit nitrogen fertilizer rate (UNFR) UNFR is a rate in lb-N per unit crop yield, where the unit can be either bushel or ton. [Note: 1 bu (US bushel) = 1.2444 ft^3, 1 British bushel = 1.2843 ft^3, 1 t (British ton) = 2,000 lb, 1 T (metric ton or mt) = 1,000 kg].

Unsaturated zone The zone immediately below the land surface where the pores contain both water and air, but are not totally saturated with water. These zones differ from an aquifer, where the pores are saturated with water.

Upland Any area that does not qualify as wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soil, and/or hydrologic characteristics associated with wetlands or is defined as open waters.

Urbanization The concentration of development in relatively small areas (cities and suburbs). The US Census Bureau defines "urban" as referring to areas with more than 1.5 people per acre.

Usable storage The volume normally available for release from a reservoir below the stage of the maximum controllable level.

Variance State or the US EPA permission not to meet a certain drinking water standard. The water system must prove that (1) it cannot meet a MCL, even while using the best available treatment method, because of the characteristics of the raw water, and (2) the variance will not create an unreasonable risk to public health. The state or the US EPA must review, and allow public comment on, a variance every 3 years. States can also grant variances to water systems that serve small populations and which prove that they are unable to afford the required treatment, an alternative water source, or otherwise comply with the standard.

Vector attraction Characteristics (e.g., odor) that attract birds, insects, and other animals that are capable of transmitting infectious agents.

Vectors Vectors include rodents, birds, insects that can transport pathogens away from the land application site.

Violation A failure to meet any state or federal drinking water regulation.

Volatile solids (VS) Volatile solids (VS) provide an estimate of the readily decomposable organic matter in biosolids and are usually expressed as a percentage of total solids. VS are an important determinant of potential odor problems at land application sites.

Volatilization Ammonium-N in biosolids/manure can be significant, making up even half the initial PAN of biosolids/manure. The ammonium-N of biosolids/manure can vary widely depending on treatment and storage. Since ammonium-N is prone to volatilization (as ammonia gas, NH_3), the application method affects PAN. For instance, surface applied biosolids are expected to lose half of their ammonium-N. Conversely, direct subsurface injection or soil incorporation of biosolids within 24 h minimizes volatilization losses. The conversion of ammonium-N to ammonia gas form (NH_3) is called volatilization.

Vulnerability assessment An evaluation of drinking water source quality and its vulnerability to contamination by pathogens and toxic chemicals.

Wadeable stream A stream, creek, or small river that is shallow enough to be sampled using methods that involve wading into the water. Wadeable streams typically include waters classified as first through fourth order in the Strahler Stream Order Classification system.

Wastewater Water that has been used in homes, industries, and businesses that is not for reuse unless it is treated.

Wastewater-treatment return flow Water returned to the environment by wastewater-treatment facilities.

Water balance See Hydrologic budget.

Water conservation Promotion of the efficient use of water through the economically or socially beneficial lessening of water withdrawals, water use, or wastewater reduction. Conservation can forestall future water supply capacity needs and can be implemented on water supply as well as on water demand. It can consist of both temporary and permanent measures for improvement of both water quantity and water quality.

Water content of snow See Water equivalent of snow.

Water crop See Water yield.

Water cycle The circuit of water movement from the oceans to the atmosphere and to the Earth and return to the atmosphere through various stages or processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transportation.

Water equivalent of snow Amount of water that would be obtained if the snow should be completely melted. Water content may be merely the amount of liquid water in the snow at the time of observation.

Water loss The difference between the average precipitation over a drainage basin and the water yield from the basin for a given period. The basic concept is that water loss is equal to evapotranspiration, that is, water that returns to the atmosphere and thus is no longer available for use. However, the term is also applied to differences between measured inflow and outflow even where part of the difference may be seepage.

Water quality A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Water quality standard (WQS) The combination of a designated use and the maximum concentration of a pollutant which will protect that use for any given body of water. For example, in a trout stream, the concentration of iron should not exceed 1 mg/L.

Water quality standards Standards that set the goals, pollution limits, and protection requirements for each waterbody. These standards are composed of designated (beneficial) uses, numeric and narrative criteria, and anti-degradation policies and procedures.

Water requirement The quantity of water, regardless of its source, required by a crop in a given period of time, for its normal growth under field conditions. It includes surface evaporation and other economically unavoidable wastes.

Water table (1) The top of the water surface in the saturated part of an aquifer; (2) the upper surface of a zone of saturation; (3) the boundary between the saturated and unsaturated zones. Generally, the level to which water will rise in a well (except artesian wells).

Water use Water that is used for a specific purpose, such as for domestic use, irrigation, or industrial processing. Water use pertains to human's interaction with and influence on the hydrologic cycle and includes elements, such as water withdrawal from surface- and groundwater sources, water delivery to homes and businesses, consumptive use of water, water released from wastewater-treatment plants, water returned to the environment, and instream uses, such as using water to produce hydroelectric power.

Water year In the US Geological Survey reports dealing with surface-water supply, it is the 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and includes 9 of the 12 months. Thus, the year that ended last September 30, 1959, is called the "1959 water year."

Water yield (water crop or runout) The runoff from the drainage basin, including groundwater outflow that appears in the stream plus groundwater outflow that bypasses the gaging station and leaves the basin underground. Water yield is the precipitation minus the evapotranspiration.

Watershed (1) A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place at a lower elevation. (2) The land area from which water drains into a stream, river, or reservoir. (3) Land area that drains to a common waterway, such as a stream, lake, estuary, wetland, or ultimately the ocean. (4) The land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large watersheds, like the Mississippi River basin, contain thousands of smaller watersheds. (5) The divide separating one drainage basin from another and in the past has been generally used to convey this meaning. However, over the years, the use of the term to signify drainage basin or catchment area has come to predominate, although drainage basin is preferred. Drainage divide, or just divide, is used to denote the boundary between one drainage area and another.

Watershed approach A flexible framework for managing water resource quality and quantity within a specified drainage area or watershed. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology.

Watershed plan A document that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to development and implementation of the plan.

Watershed protection approach (WPA) The US EPA's comprehensive approach to managing water resource areas, such as river basins, watersheds, and aquifers. WPA contains four major features: targeting priority problems, stakeholder involvement, integrated solutions, and measuring success.

Water-treatment plant A facility designed to receive and treat the raw surface water, raw groundwater, or rainwater for production of drinking water meeting the government's drinking water standards or for production of industrial water meeting the specific industrial water quality standards.

Watt-hour (Wh) An electrical energy unit of measure equal to 1 W of power supplied to, or taken from, an electrical circuit steadily for 1 h.

Well (water) An artificial excavation put down by any method for the purposes of withdrawing water from the underground aquifers. A bored, drilled, or driven shaft or a dug hole whose depth is greater than the largest surface dimension and whose purpose is to reach underground water supplies or oil or to store or bury fluids below ground.

Wellhead protection area The area surrounding a drinking water well or well field which is protected to prevent contamination of the well(s).

Wetland (1) An area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (2) An area where water covers the soil or is present either at or near the surface of the soil all year (or at least for periods of time during the year). (3) Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetland generally includes swamps, marshes, bogs and similar areas.

Width/depth ratio The width to depth ratio describes a dimension of bankfull channel width to bankfull mean depth. Bankfull discharge is defined as the momentary maximum peak flow which occurs several days a year and is related to the concept of channel-forming flow.

Width/meander length ratio The ratio of the average width of a stream or river over a reach divided by the average length over successive cycles of left and right bends of the stream or river.

Wildlife refuge An area designated for the protection of wild animals, within which hunting and fishing are either prohibited or strictly controlled.

Withdrawal Water removed from a ground- or surface-water source for use.

Withdrawal use of water The water removed from the ground or diverted from a stream or lake for use.

Xeriscaping A method of landscaping that uses plants that are well adapted to the local area and are drought resistant. Xeriscaping is becoming more popular as a way of saving water at home.

Yield (1) It is the crop harvested in the unit of bu/acre or ton/acre. (2) Mass per unit time per unit area.

Zone of aeration The zone above the water table. Water in the zone of aeration does not flow into a well.

Zone of saturation The zone in which the functional permeable rocks are saturated with water under hydrostatic pressure. Water in the zone of saturation will flow into a well and is called groundwater.

8. REFERENCES

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