



Designation: D4581 – 86 (Reapproved 2005)

Standard Guide for Measurement of Morphologic Characteristics of Surface Water Bodies¹

This standard is issued under the fixed designation D4581; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers the methods used for defining the morphologic characteristics of surface water bodies. This guide references manuals that provide various rationale and procedures necessary to conduct a morphologic survey.

1.2 The references were written for specific agency use and may not be applicable in all cases (1–6).²

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*³

D1129 Terminology Relating to Water

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology **D1129**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *large water bodies*—water areas large enough to require use of electronic horizontal positioning devices.

3.2.2 *morphologic surveys*—surveys made to determine shape, depth, and volume of water bodies; also density,

distribution, and volume of sediment and characteristics of watersheds contributing to the water body.

3.2.3 *small water bodies*—water areas that can be surveyed using stretched cables or visual triangulation for horizontal positioning.

4. Summary of Guide

4.1 This document provides guidance for conducting measurements and assembly of data into a standard format that facilitates comparative analysis of water body morphology on a national basis.

5. Significance and Use

5.1 No other standards presently exist for the survey of water body morphologic characteristics. The techniques described in the references represent the present state-of-art and contain sufficient information to inform geologists and engineers of the kinds of information to be gathered and the techniques to be used.

5.2 The major categories of methodologies described in the references are: sounding, positioning, land surveys, sediment properties, sediment sampling techniques, photogrammetric methods, calculating volume and area, morphologic base data, weighted sediment dry weight, reservoir operations, equipment, and reporting results.

5.3 The references are intended as operational manuals and do not describe experimental design.

6. Procedure

6.1 The references provide detailed information and procedures as follows:

6.1.1 *Field Investigations*—Section 3, Chapter 7 of the *SCS National Engineering Handbook* describes field investigations and survey techniques (1). Pages 1 to 31 specifically describe equipment, methods, notekeeping, computations, and reports for small water bodies.

6.1.2 *Sedimentation Surveys*—Specifications were prepared by the Soil Conservation Service to allow contracting for services to perform reservoir sedimentation surveys on small water bodies (2). These specifications are intended to meet SCS needs and should be used by others only as a guide in preparing their own material.

¹ This guide is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.07 on Sediments, Geomorphology, and Open-Channel Flow.

Current edition approved June 1, 2005. Published June 2005. Originally approved in 1986. Last previous edition approved in 2001 as D4581 – 86 (2001). DOI: 10.1520/D4581-86R05.

² The boldface numbers in parentheses refer to the list of references at the end of this guide.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

6.1.3 *Methods for Water-Data Acquisition*—Descriptions of various techniques for measuring sediment are contained in Ref (3). The section on reservoir surveys provides guidance about the kinds of work to be done and features to be considered. However, it is not intended as a detailed operational manual. The scope of small and large reservoirs is covered.

6.1.4 *Monitoring Reservoir Sedimentation*—Detailed descriptions of most aspects of performing reservoir sedimentation surveys that are applicable to small and large reservoirs are found in Ref (4). Main topics include base reservoir data, selection of surveying method, and hydrographic surveys.

6.1.5 *Hydrographic Parameters in Large Sand-Bed Streams*—Many techniques are described in varying detail (5). The techniques are suitable for reservoirs, lakes and streams. The main topics are hydrographic investigation programs, horizontal positioning equipment and techniques, soundings, velocity measurements and suspended-sediment, bedload and bed-material sampling.

6.1.6 *Hydrographic Manual*—Detailed description of procedures applicable to large water bodies is provided (6). Many described techniques, such as echo sounding, are applicable to small water bodies. The manual is divided into three major

elements: hydrographic field operations, final data processing, and appendices. Detailed information is provided on equipment, instruments, and special survey techniques.

7. Report

7.1 All morphologic surveys should report their results in a format sufficient to include the necessary elements to describe where and when the survey was performed, what methods were used and how precisely they were applied, and what were the measured results. Appendix X1 contains a data summary form currently used by several U.S. government and state agencies. Appendix X2 is a list of additional factors to be considered when reporting results.

8. Precision and Bias

8.1 The precision is a function of the conditions encountered and the measurement techniques used for each individual survey.

9. Keywords

9.1 bathymetric survey; reservoir sediment; reservoir survey; sedimentation

APPENDIXES

(Nonmandatory Information)

X1. SUBCOMMITTEE ON SEDIMENTATION (ICWR) INSTRUCTIONS FOR COMPILING THE RESERVOIR SEDIMENT DATA SUMMARY FORM ⁴

X1.1 The following instructions were prepared by members of the Subcommittee as a guide for use in the completion of Reservoir Sediment Data Summary forms. The purpose of the summary form is to provide for the uniform compilation and dissemination of pertinent basic data obtained from reservoir sedimentation surveys. A summary is desired for each reservoir on which one or more sedimentation surveys have been made. New summaries should be prepared when additional sedimentation surveys are made and should carry forward the results of previous surveys, as indicated in the instructions. A typed copy of each new summary in condition suitable for offset printing should be furnished for publication. After a summary is prepared it will be reproduced by the Subcommittee in sufficient numbers to meet the needs of each agency represented on the Subcommittee. This will permit each agency to maintain a file of basic data prepared in a uniform manner suitable for analysis and interpretation. The Subcommittee recognizes that all items of data provided for on the summary will not be

readily available for every reservoir. The early compilation and dissemination of available data is preferable to postponement until all items can be completed. However, it is important that every item be filled out for which data are obtainable. The following instructions are based on the instructions issued by the Subcommittee on Sedimentation in 1961 but are revised to apply to the new summary form.

X1.1.1 Figs. X1.1 and X1.2 provides a reservoir data summary form. Figs. X1.3 and X1.4 is a reservoir data summary form in SI units. Figs. X1.5 and X1.6 is an example of a completed reservoir data summary form. A complete description of each item on the form is given in X1.3.

X1.2 General Notes:

X1.2.1 In all cases where data are estimated or assumed, insert an asterisk, and show an asterisk with the word “assumed” at the bottom of the front page of the form.

X1.2.2 Where other information is presented that needs clarification, footnotes should be used and shown by numbers, as ¹, ², etc. All footnotes are to be explained in the space provided under Item 47.

X1.2.3 All data should be shown to at least three significant figures, if available, and if accuracy of the survey warrants. However, it is common practice and permissible to show all items of data to the nearest whole number, even though the

⁴Prepared by the following agencies represented on the Subcommittee on Sedimentation Inter-Agency Committee on Water Resources: Department of Agriculture: Agricultural Research Service, Forest Service, Soil Conservation Service; Department of Commerce: Bureau of Public Roads, Environmental Science Services Administration; Department of Defense: Corps of Engineers, Naval Oceanographic Office; Department of Health, Education and Welfare: Water Pollution Control Administration; Department of the Interior: Bureau of Mines, Bureau of Reclamation, Geological Survey; Federal Power Commission; and Tennessee Valley Authority.



RESERVOIR SEDIMENT
DATA SUMMARY

		NAME OF RESERVOIR				DATA SHEET NO.		
DAM	1. OWNER	2. STREAM			3. STATE			
	4. SEC.	TWP.	RANGE		5. NEAREST P. O.		6. COUNTY	
	7. LAT.	LONG.	8. TOP OF DAM ELEVATION		9. SPILLWAY CREST ELEV.			
RESERVOIR	10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. ORIGINAL SURFACE AREA, ACRES	13. ORIGINAL CAPACITY, ACRE-FEET	14. GROSS STORAGE, ACRE-FEET	15. DATE STORAGE BEGAN		
	a. FLOOD CONTROL							
	b. MULTIPLE USE							
	c. POWER							
	d. WATER SUPPLY					16. DATE NORMAL OPER BEGAN		
	e. IRRIGATION							
	f. CONSERVATION							
	g. INACTIVE							
WATERSHED	17. LENGTH OF RESERVOIR		MILES, AV. WIDTH OF RESERVOIR		MILES			
	18. TOTAL DRAINAGE AREA		SQ. MI.		22. MEAN ANNUAL PRECIPITATION		INCHES	
	19. NET SEDIMENT CONTRIBUTING AREA		SQ. MI.		23. MEAN ANNUAL RUNOFF		INCHES	
	20. LENGTH		MILES, AV. WIDTH		24. MEAN ANNUAL RUNOFF			
	21. MAX. ELEV.		MIN. ELEV.		25. ANNUAL TEMP: MEAN RANGE			
SURVEY DATA	26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA, ACRES	32. CAPACITY, ACRE-FEET	33. C/I RATIO, AC.-FT. PER AC.-FT.
	26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION		35. PERIOD WATER INFLOW, ACRE-FEET			36. WATER INFL. TO DATE, AC.-FT.	
		a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	a. MEAN ANNUAL	b. TOTAL TO DATE		
	26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, ACRE-FEET			38. TOTAL SED. DEPOSITS TO DATE, ACRE-FEET			
		a. PERIOD TOTAL	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	a. TOTAL TO DATE	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	
	26. DATE OF SURVEY	39. AV. DRY WGT. LBS. PER CU. FT.	40. SED. DEP., TONS PER SQ. MI.-YR.		41. STORAGE LOSS, PCT.		42. SED. INFLOW, PPM	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANN.	b. TOT. TO DATE	a. PERIOD	b. TOT. TO DATE	

FIG. X1.1 Reservoir Sediment Data Summary Form, Inch-Pound Units

accuracy of the survey may not give significance to the last one or two whole numbers. For example, for Item 14: 167 624, 16 762, 1676, 168, 16.8, 1.68.

X1.2.4 *Items 31, 32, 33, 37, 38, 40, 41*—Where the sedimentation survey of a multiple-purpose reservoir has covered only the pool level of levels used for storage most of the year (as irrigation, power, inactive) and has not covered the flood-control pool above such levels, the data should be shown for the pool levels surveyed. However, any data obtained concerning sedimentation in the controllable flood-control pool (not including surcharge storage) should be shown under the above items with a footnote reference of explanation under Item 47.

X1.2.5 Use continuation sheets when all data cannot be placed on one sheet.

X1.3 *Specific Items*—Descriptions of the numbered items as they appear in Fig. X1.1, Fig. X1.3, and Fig. X1.5 are given as follows:

X1.3.1 *Name of Reservoir*: Give the official or most commonly used name. If the dam has another name, give it in parentheses, for example, Lake Mead (Hoover Dam).

X1.3.2 *Data Sheet No.*— The data sheet number is composed of two parts. The first is the river basin map number as shown in the hydrologic atlas compiled under the auspices of the Subcommittee on Hydrology (ICWR), and the second is the sheet reference number periodically supplied by the Subcommittee on Sedimentation when data are compiled for publication. If the map number for the river basin in which the reservoir is located is available, it should be shown here. The

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW, AND ABOVE, CREST ELEVATION													
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION													
26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR													
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-115	-120
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION													
45. RANGE IN RESERVOIR OPERATION														
WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.							
46. ELEVATION-AREA-CAPACITY DATA														
ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY						
47. REMARKS AND REFERENCES														
<p align="center">ASTM D4581-86(2005)</p> <p align="center">https://standards.iteh.ai/catalog/standards/sist/0ecf785b-96d1-4a64-a1fd-cbf760dc5f55/astm-d4581-862005</p>														
48. AGENCY MAKING SURVEY										50. DATE _____				
49. AGENCY SUPPLYING DATA														

FIG. X1.2 Continued

data sheet reference number will be supplied later by the Subcommittee on Sedimentation.

X1.3.3 *Item 1*— The name of the person or the organization that owns or operates the structure. If a federal or state government, give both the department and agency having supervision or control over the operation of the dam. (Abbreviate as necessary.)

X1.3.4 *Item 2*— If the reservoir is located on a small stream, the name of which is not known, list the stream as a tributary of the next largest stream, for example, "Trib. of Rock R."

X1.3.5 *Item 3*— If the dam lies in two states, both states should be listed. List first the state that is the location for dam operation headquarters.

X1.3.6 *Item 4*— Give the location of the dam by section, township, and range.

X1.3.7 *Item 5*— Give the name of the nearest post office. If space permits, help pinpoint the location of the dam by adding the distance in miles and the direction of the dam from the nearest post office, such as Tulsa 2 SE.

X1.3.8 *Item 6*— Give the county in which the dam is located. If the dam is in two counties, list first the county that is the location for dam operation headquarters, followed by a hyphen and the name of the second county.

X1.3.9 *Item 7*— Give the latitude and longitude of the dam in degrees and minutes (seconds, if known).

X1.3.10 *Item 8*— The elevation of the top of the dam that is equal to the highest spillway elevation (Item 9) plus freeboard.



RESERVOIR SEDIMENT
DATA SUMMARY

		NAME OF RESERVOIR				DATA SHEET NO.			
DAM	1. OWNER	2. STREAM			3. STATE				
	4. SEC.	TWP.	RANGE		5. NEAREST P. D.		6. COUNTY		
	7. LAT.	LONG.	8. TOP OF DAM ELEVATION		m	9. SPILLWAY CREST ELEV			
RESERVOIR	10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL, m		12. ORIGINAL SURFACE AREA, Km ²	13. ORIGINAL CAPACITY, m ³	14. GROSS STORAGE, m ³	15. DATE STORAGE BEGAN		
	a. FLOOD CONTROL								
	b. MULTIPLE USE								
	c. POWER								
	d. WATER SUPPLY						16. DATE NORMAL OPER BEGAN		
	e. IRRIGATION								
	f. CONSERVATION								
g. INACTIVE									
WATERSHED	17. LENGTH OF RESERVOIR			Km	AV. WIDTH OF RESERVOIR			Km	
	18. TOTAL DRAINAGE AREA			Km ²	22. MEAN ANNUAL PRECIPITATION			m.m	
	19. NET SEDIMENT CONTRIBUTING AREA			Km ²	23. MEAN ANNUAL RUNOFF			m.m	
	20. LENGTH		Km	AV. WIDTH		Km	24. MEAN ANNUAL RUNOFF		m ³
	21. MAX. ELEV.	m	MIN. ELEV.	m	25. ANNUAL TEMP: MEAN			RANGE °C	
SURVEY DATA	26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA, Km ²	32. CAPACITY, m ³	33. C/I. RATIO, m ³ per m ³	
	26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION		35. PERIOD WATER INFLOW, m ³			36. WATER INFL. TO DATE, m ³		
		a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	a. MEAN ANNUAL	b. TOTAL TO DATE			
	26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, m ³			38. TOTAL SED. DEPOSITS TO DATE, m ³				
		a. PERIOD TOTAL	b. AV. ANNUAL	c. PER Km ² /YEAR	a. TOTAL TO DATE	b. AV. ANNUAL	c. PER Km ² /YEAR		
	26. DATE OF SURVEY	39. AV. DRY WGT., Kg/m ³		40. SED. DEP., Mg/Km ² /yr		41. STORAGE LOSS, PCT.		42. SED. INFLOW, mg/l	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANN.	b. TOT. TO DATE	a. PERIOD	b. TOT. TO DATE		

FIG. X1.3 Reservoir Sediment Data Summary Form, SI Units

NOTE X1.1—In items 8, 9 and 21, if no actual sea level datum elevation is available, an assumed elevation or local datum plane should be given for these items wherever possible so that the height of the dam and the spillway above stream bed can be determined. (Observe X1.2.1 under General Notes.)

X1.3.11 *Item 9*— This is the elevation of the highest spillway. If the spillway is topped by movable gates, give the elevation of the top of the gates in closed position, with an explanatory footnote in Item 47 “Remarks and References.” (See X1.2.2 under General Notes.)

X1.3.12 *Items 10 to 14*—All data corresponding to storage allocations 10a to g refer to original storages in the reservoir, if these data are available, or otherwise, to the first accurate capacities determined after the beginning of storage. Show revisions of the initial storages if recent surveys yield more accurate data than the early surveys.

X1.3.13 *Item 10a and b*—These items designate the purpose of storage space allocation. Multiple-use storage space (Item 10b) is purposely varied, seasonally or alternately, as required to serve two or more purposes. Use a footnote to explain the specific uses in Item 47.

X1.3.14 *Item 10c*— This item ordinarily refers to storage for hydroelectric or direct power development. However, storage developed or allocated specifically for cooling purposes in steam power plant operation should be listed under this item with a footnote explanation in Item 47.

X1.3.15 *Item 10d*— This item refers to water supply for municipal, industrial, domestic or livestock use, and fire protection.

X1.3.16 *Item 10e*— This item refers to storage space allocated specifically for water used to irrigate agricultural land.

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN m BELOW, AND ABOVE, CREST ELEVATION												
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION												
26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR												
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION												
45. RANGE IN RESERVOIR OPERATION													
WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, m ³	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, m ³						
46. ELEVATION-AREA-CAPACITY DATA													
ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY					
47. REMARKS AND REFERENCES													
ASTM D4581-86(2005)													
https://standards.iteh.ai/catalog/standards/sist/0ecf785b-96d1-4a64-a1fd-cbf760dc5f55/astm-d4581-862005													
48. AGENCY MAKING SURVEY										50. DATE _____			
49. AGENCY SUPPLYING DATA													

FIG. X1.4 Continued

X1.3.17 *Item 10f*— This item refers to storage allocated for regulation of low-water flow of streams, navigation pools, recharge of ground water, recreation, fish and wildlife, etc. Specify with a footnote.

X1.3.18 *Item 10g*— This refers to storage below the lowest outlet in the dam that cannot be withdrawn for any consumptive or beneficial use and is not generally considered to be of significant value for any purposes listed under Item 10f, “Conservation.” This pool elevation in small reservoirs generally is considered by the Department of Agriculture to be the sediment pool elevation. It is the level below which sediment

is generally continually submerged and above which the sediment deposits tend to be more compacted due to periodic exposure to the air.

X1.3.19 *Items 11a to g*—These elevations should correspond to the top of pools listed under Item 10, in terms of mean sea level, if known. Otherwise, an assumed elevation or local datum should be given, as relative elevation to the streambed level, the top of the dam or the spill-way crest. If regulation schedules provide for variation (seasonal or otherwise) in the