QUALITY SYSTEM
ISO 9001
CERTIFIED

HYDROLOGICAL SERVICES PTY LTD

PO BOX 332, LIVERPOOL B.C NSW 1871, AUSTRALIA
Phone: (Int.) 612 9601 2022 Fax: (Int.) 612 9602 6971
Phone: (Nat.) (02) 9601 2022 Fax: (Nat.) (02) 9602 6971

Email: sales@hydrologicalservices.com

Web: www.hydrologicalservices.com

CONTENTS

HYDROLOGICAL SERVICES WARRANTY TERMS

WARRANTY, DISCLAIMER AND LIMITATION OF LIABILITY:

We warrant this product to be free from defects in material and workmanship for a period of three years from the date of shipment hereof or its total rated life, whichever first occurs. During the warranty period, we will repair or replace this product if it is returned to us with shipping charges prepaid and we determine it to be defective. This warranty shall not apply if this product has been subjected to misuse, negligence, accidents, or misapplied, or modified or repaired by unauthorised persons, or improperly installed, and we shall not be liable to any person for personal injury or property damage caused by such a product.

All other warranties, express and implied, including warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE, are disclaimed. All other remedies and liabilities, including incidental, consequential, and special damages, losses, and expenses, are excluded.

Note: It is Hydrological Services' policy to support all of our products. If design or workmanship problems arise after this statuary warranty period we request that you contact us.

INTRODUCTION

D-49 Sediment Sampler

The D-49 is a sampler for suspension by gauging winch to take suspended sediment samplers in streams not greater than 4.6 m in depth. The head of the sampler is hinged to permit access to the sample container. Tail fins are provided to orient the instrument into the stream flow. The head of the sampler is drilled and tapped to receive the 6.3mm (1.4"), 4.8mm (3/16"), or 3.2mm (1/8") intake nozzle which projects into the current for collecting the sample. A port which points downstream is provided on the side of the sampler head from which air escapes as it is displaced by the sample being collected in the container. The instrument is mounted on a hanger bar and attached to the suspension cable on a gauging winch for lowering and raising. Suspension equipment and sample containers are optional extras.

SEDIMENT SAMPLER SUPPORT EQUIPMENT

Sediment-sampling equipment has been designed by Hydrological Services to facilitate the use of existing support equipment normally used in stream-gauging procedures. In addition to wading rods and hand lines Hydrological Services provides support equipment is generally necessary for the proper operation of the heavier versions of sediment samplers. In general, support equipment consists of steel cable, hanger bars, winches, automated cableways. However, specific conditions at a site may dictate what support equipment is required to improve ease of handling in response to the local conditions and ensure the safety of the person taking the measurements.

SITE SELECTION

The selection procedure for establishing a sampling location should emphasize the quest for a stream-data site. A stream-data site is best defined as a cross section displaying relatively stable hydrologic characteristics and uniform depths over a wide range of stream discharges, from which representative water quality and sediment data can be obtained and related to a stage-discharge rating for the site. This is a rather idealised concept because the perfect site is rare at best. Therefore, it is necessary to note the limitations of the most suitable site available and build a program to minimize the disadvantages and maximize the advantages. Most often, sampling sites are located at or near existing gage sites, which may not always be well suited to water-quality and sediment-data collection. For this reason, future sites selected for stream gauging should be carefully assessed for suitability as a water-quality and sediment-sampling site. As indicated, the site should be at or near a gauging station because of the obvious relation of sediment movement to the flow of the stream. If the sediment measuring site is more than a few hundred feet from the water-stage recorder or at a site other than where the water-discharge measurement is made, it may be desirable to install a simple non recording stage indicator at the site so that a correlation of the flow conditions between the sediment and the distant water measuring sites can be developed. The obvious difficulties with inflow between the sites from small tributaries also should be avoided where possible.

Sites that may be affected by backwater conditions should be avoided whenever possible. Backwater affects both the stage-discharge and velocity-discharge relation at the site. Therefore, a given discharge may have varying stage and mean stream velocity and thus have varying sediment transport rates. If a site is affected by backwater, samples will have to be collected more frequently, and the cost in both man hours and money will be significantly higher than for more “normal” sites. A sediment-measuring site downstream from the confluence of two streams also may require extra sediment measurements. The downstream site may be adequate for water-discharge measurement, but could present problems if used as a sediment-measuring site due to incomplete mixing of the flows from the tributaries. Therefore, it might be desirable to move far enough downstream to ensure adequate mixing of the tributary flows. As indicated in Book 3, Chapter Cl, “Fluvial Sediment Concepts” (Guy, 1970, p. 24), the distance downstream from a confluence that is required for complete mixing depends on the stream velocity, depth, and mixing width. If the flow at a sediment-measuring site is not mixed, extra samples will be required on a continuing basis because the relative flow quantity and sediment concentration from the two tributaries will change with time. Aside from the confluence or tributary problem, the type of cross section for flow both in the channel and on the flood plain may affect the ease with which data can be obtained and the quality of the samples. The ratio of suspended load to total load and its variation with time can be greatly affected by the width-depth ratio, especially for sand-bed streams. For sites where the data are expected to be correlated with channel properties and the landforms of the region, a normal or average section should be used. When a fixed-routine sampling installation is used, a measuring section at a bend may provide a more stable thalweg and, hence, a more uniform adjustment coefficient with respect to time than one at a crossover. Sites in areas of active bank erosion should be avoided. As a result of economic necessity, most sediment measuring sites are located at highway bridges. These bridges are often constructed so that they restrict the flow width, or they may be located at a section where the channel is naturally restricted in width.

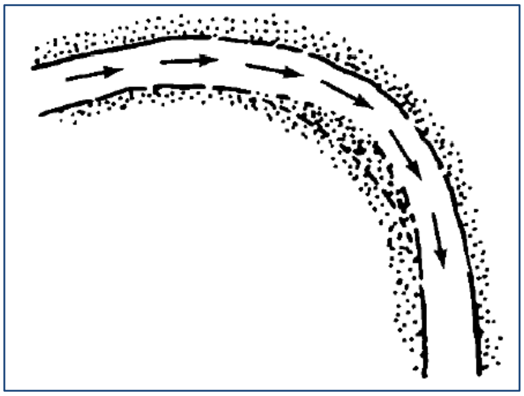


Figure 3A.
Natural constriction of channel at bend

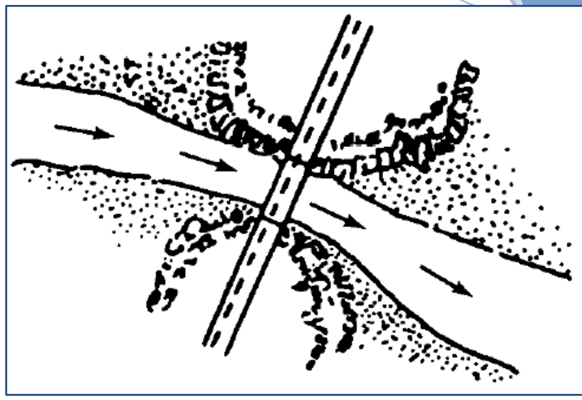


Figure 3B.
Natural constriction of channel by persistent bedrock

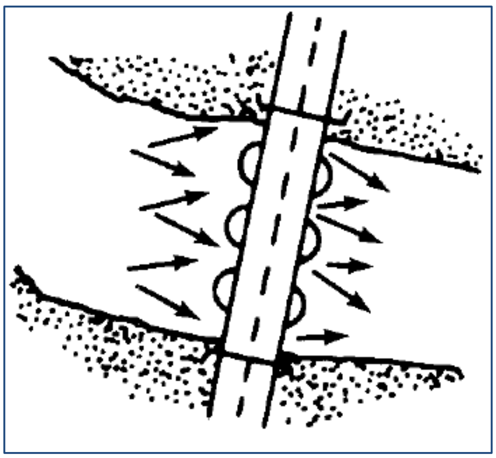


Figure 3C.
Constriction of channel by massive piers

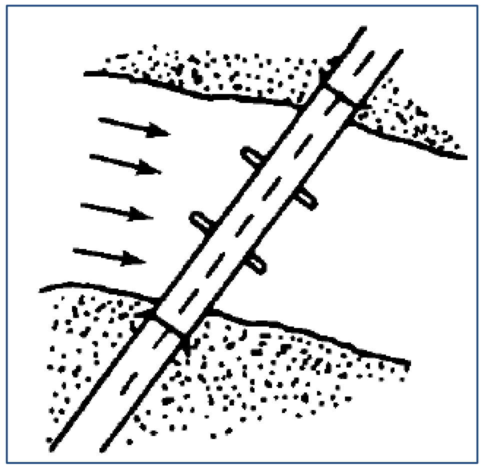


Figure 3D.
Effective constriction of channel by long skewed piers

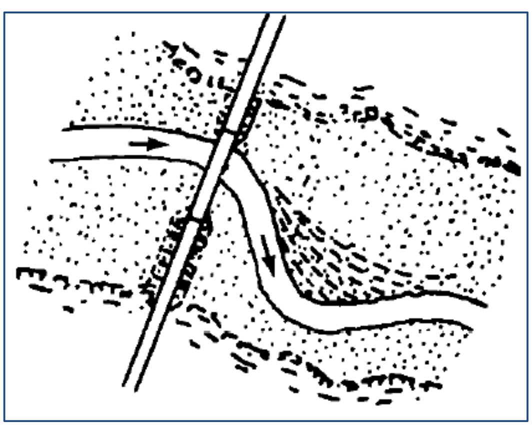


Figure 3E.
Constriction of flood plain by embankments

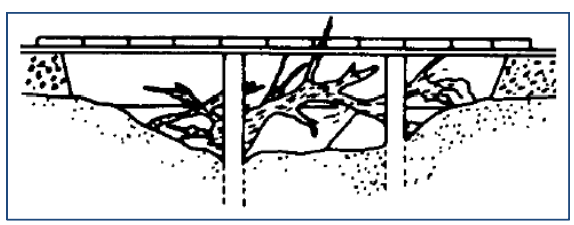


Figure 3F.
Constriction of flow by accumulation of debris

Figure 3 (Culbertson and others, 1967) illustrates the conditions at several kinds of natural and artificially induced flow constrictions. As expected, the sand-bed type of stream causes the most serious flow problems with respect to scour in the vicinity of such constrictions. Even if the bridge abutments do not interfere with the natural width of the stream, the bridge may be supported by several midstream piers that can interfere with the stream flow lines and, thereby, reduce the effective cross-sectional area. As indicated in figure 26F, midstream piers can catch debris and, thereby, interfere with effective sediment sampling.

Because sediment samples must be obtained more frequently during floods, it is imperative that a site be selected where obtaining data during times of flooding is feasible. That is, particular attention should be given to the ease of access to the water-stage recorder and to a usable bridge or cable during a flood. Because of the need to collect samples frequently during floods, many of which occur at night, sites accessible only by poorly maintained back roads or trails should be avoided. Sometimes the choice of a sediment-measuring site also must be determined by the availability of a suitable observer to collect the routine samples.

In choosing a sediment-measurement site, it should be emphasized that samples need to be collected at the same cross-section location throughout the period of record. Different sampling cross sections can be used, if absolutely necessary, during the low-water wading stage and the higher stages requiring the use of a bridge or cableway. Although the total sediment transported through the different cross sections is probably equal at a given flow stage, the percentage of that total load represented by suspended-sediment load may be drastically different from one cross section to the other, due to differences in hydraulic and sediment-transport characteristics. When data computations are performed, these differences must be considered because the data may not be compatible, and the usefulness of the data in answering the objectives of the sampling program could be threatened. Sites where highway or channel realignment or other construction is anticipated during the period of record should be avoided. Good photographs of proposed or selected sediment-measuring sites are necessary to help document such features as channel alignment, water-surface conditions at various stages, composition of bed and bank material (at low flow), and natural or man-made features, which could affect the water-discharge and (or) sediment-discharge relations. Such pictures and extensive field notes are particularly useful when deciding on alternatives among sites and in later consideration of environmental changes at the site(s).

EQUIPMENT SELECTION & MAINTENANCE

Before departing on a field trip where sediment data are to be collected, a field person should assemble and check all equipment needed to collect the best samples and related measurements. For example, if data are needed for total-load computation, equipment is needed for water-discharge measurement, suspended- sediment sampling, bedload sampling, and (or) bed- material sampling. If suspended-sediment concentration and particle-size profiles are required, point samplers and water-discharge-measuring equipment will be needed. Some of the special equipment used only at one location may be stored in the station gauge house, with the observer, or in special storage shelters or boxes. However, a sampler or some support equipment could be damaged or stolen without the observer noticing or reporting the loss. Hence, it is necessary for field personnel to carry repair equipment, spare parts (including nozzles and gaskets), and perhaps even an extra sampler. The stream flow conditions and sampling structures (bridge, cableway, or other) determine more specifically which sampler or samplers should be used at a station. Stream depth determines whether hand samplers, such as the DH-48 or cable suspended samplers, such as the D-49. Depths over 4.5 metres (15 feet) will require the use of point samplers as depth-integrating samplers to avoid overfilling or using too fast a transit rate. Stream velocities as well as depth are factors in determining whether or not a stream can be waded. A general rule is that when the product of depth in metres (feet) and velocity in metres per second (feet per second) equals 10 or greater, a stream's wad ability is questionable. Application of this rule will vary considerably among field persons according to an individual's stature and the condition of the streambed. That is, if footing is good on the streambed, a heavier field person with a stocky build will generally wade more easily than will a lighter, thinner person when a stream depth-velocity product approaching 10 exists. The depth-velocity product also affects the action of each sampler. The larger this product, the heavier and more stable the sampler must be to collect a good sample. At a new station or for inexperienced persons, considerable trial and error may be necessary to determine which sampler is best for a given stream condition.

All sampler nozzles, gaskets, and air exhausts, as well as the other necessary equipment, should be checked regularly and replaced or serviced if necessary. Sampler nozzles in particular should be checked to ensure that they are placed in the appropriate instrument or series. See the guidelines presented in table 1 to determine whether the nozzle is correct.

The correct size of nozzle to use for a given situation must often be determined by trial. As mentioned in the previous section, it is best to use the largest nozzle possible that will permit depth integration without over tilling the sample bottle or exceeding the maximum transit rate (about 0.4 of the mean velocity in the sampled vertical for most samplers with pint containers).

Table 1									
Sampler Model	**Construction Material**	**Dimensions (mm)**		**Weight (KGs)**	**Nozzle Distance from Bottom (mm)**	**Suspension Type**	**Maximum Velocity (m/s)**	**Maximum Depth (m)**	**Nozzles (inches)**
		L	**W**						
DH-48	Cast Aluminium	330	81.5	2	89	Rod	2.7	2.7	1/4” 3/16” 1/8”
DH-59	Cast Bronze	380	89	10	114	Handline	1.5	4.6	1/4” 3/16” 1/8”
D-49	Cast Bronze	815	133	28	102	Cable Reel	2	4.6	1/4” 3/16” 1/8”

If a sample bottle does not fill in the expected time, the nozzle or air-exhaust passages may be partly blocked. The flow system can be checked, as described in the section titled “Gaskets,” by sliding a length of clean rubber or plastic tubing over the nozzle and blowing through the nozzle with a bottle in the sampler. This procedure should be performed carefully, avoiding direct contact with the nozzle, thus eliminating the possibility of ingesting any pollutant that might exist on the sampler. When air pressure is applied in this manner, circulation will occur freely through the nozzle, sample container, and out the air exhaust. Obstructions can be cleared by removing and cleaning the nozzle and (or) air exhaust, using a flexible piece of multi strand wire. This procedure should be adequate for most airway obstruction problems. However, if blockage results from accumulation of ice or from damage to the sampler, a heat source must be used to melt the ice or the sampler must be repaired. Point samplers can be checked using the same technique, if the valve mechanism is placed in the sampling position while air is forced into the nozzle and through the air exhaust.

All support equipment required for sampling, such as waders, taglines, winches, and current meters, should be examined periodically, and as used, to ensure an effective and safe working condition. For example, be certain that the supporting cable to the sampler or current meter is fastened securely in the connector; if worn or frayed places are noted, the cable should be replaced. Winches with power equipment used with the heavier samplers and point samplers need a periodic operational check and battery charge. Point samplers should be checked immediately before use to determine, among other things, if the valve is opening and closing properly. By exercising such precautions, the field person will avoid unnecessary exposure to traffic on the bridge and will avoid lost sampling time should repairs and adjustments be required. Maintenance of samplers and support equipment will be facilitated if a file of instructions for assembly, operation, and maintenance of equipment can be accumulated in the field office.

OPERATION

Three Nozzles are supplied with the D-49 Sampler, one 6.3mm (1.4”), one 4.8mm (3/16”), and one 3.2mm (1/8”). In the sampling operation, the head is oriented upstream with the nozzle pointing directly into the current, and the sampler is lowered from the water surface to the stream bed and then raised to a position above the water surface. During the period of submergence a continuous filament of stream flow is collected in the sample bottle. Air displaced from the water while the sample accumulates is discharged through the air escape passage which points downstream. A fixed static head differential of 1/2 inch between the intake and exhaust facilitated sampling in low steam velocities and slack waters.

Depth- integrating suspended-sediment samplers accumulate a sample of water-sediment mixture throughout the period of submergence. However, if the container becomes completely filled during a sampling operation, the sample will not be representative and must be discarded.

Clean bottles must be used and after sampling they should be covered with suitable caps to prevent contamination or loss of sample. The capacity of the sample bottle is about 470cc. However, because the axis of the bottle is inclined to the vertical, any sample containing more than 440cc may be in error due to circulation of the water sediment mixture. The period of submergence should be sufficient to produce a sample volume less than 375cc but greater than 375cc in order to obtain a sample large enough for a laboratory analysis. It is generally preferable to retain an initial sample of less than 375cc but greater than 300cc rather than discard the sample and resample into same bottle. If the initial sample bottle is considerably less than 300cc, the stream vertical maybe integrated a second time, or even a third time, each been additive the sample bottle. A minimum sample of 350cc is suggested, but sufficient latitude in minimum sample volume should be permitted to avoid retaking a large number of samples.

The D-49 suspended-sediment sampler should normally be used in stream depths of 15 feet or less, but depths of 20 feet can be sampled if necessary. These depths presume that sampling occurs throughout both the descending and ascending trips in the stream vertical. In general the largest diameter nozzle that can be used within the operational limits of the equipment and personnel should be selected. However, a nozzle size which would require transit rates that are too great to be handled conveniently should not be selected. A transit rate which will produce a sample of not less than 350cc and not more than 440cc should be used for stream depth not less than 10 to 15 feet, and 400 to 440cc for stream depth greater than 15 feet but not greater than 20 feet.

The volume of sample collected at a vertical is dependant primarily upon the local stream velocity and the duration of submergence of instrument. Because the operator has no control over the stream velocity and depth encountered, he must regulate the volume of the sample by selecting a nozzle of appropriate size or by varying the sampling time (total time of submergence of the instrument).

A chart showing the relation between stream velocity and corresponding filling time (time of submergence of the sampler) to produce samples 395cc in volume for three standard nozzle diameters is attached. The filling time in seconds represents that total time of submergence of the instrument, that is, the time involved in traversing the stream vertical in both the downward and upward directions. Use of these filling time curves will provide acceptable sample volumes and will permit minor variations in the total time of submergence without invalidating the sample. Enter the sampling time curve with the stream velocity and determine the sampling time to secure a sample volume of 395cc. for the respective nozzle sizes. Then select the largest diameter nozzle that can be traversed conveniently throughout the depth of the stream in the time indicated, at a uniform rate throughout each direction of travel.

If the estimated mean velocity of flow in a stream vertical is 4 feet per second, a sediment sampler equipped with ¼ -inch diameter intake nozzle will accumulate a sample of 395 cc. in 10 seconds of submergence. The sampler must be lowered from the ware surface to the stream bed at a uniform rate in 5 seconds and raised from the bed of the stream at a uniform rate to break the water surface at the expiration of the remaining 5 seconds. The time used in traversing the stream vertical need to be the same in both directions of travel. However, the rate at which the sampler moves vertically in any one direction must remain uniform. Thus, in the above example, the stream vertical could be traversed at a uniform downward rate in 60 seconds and at a uniform rate upward to clear the water surface in 4 seconds, a total submergence period of 10 seconds. If the ¼ - inch diameter nozzle requires a vertical transit rate greater than allowable for the stream depth then a smaller diameter nozzle should be used.

A clean bottle must be used for each separate sediment sample; at least one suspended-sediment sample is taken at each sampling vertical in the cross section. When a filled sample bottle is removed from the sampler it is immediately capped to prevent contamination and appropriately marked. Pertinent information for every sample should be recorded to include the following:

Name of stream
Precise location on the stream (vertical)
Location of the cross section.
The stream depth covered by the sample.
Stage of the stream (gage height)
Date.
Time of day.
Identification applied to sampling personnel.

In addition to the above, the following information may be useful also;

Sampling time (sampler submergence time)
Water temperature
Coordination with sample groups.
Individual identifying sample number.

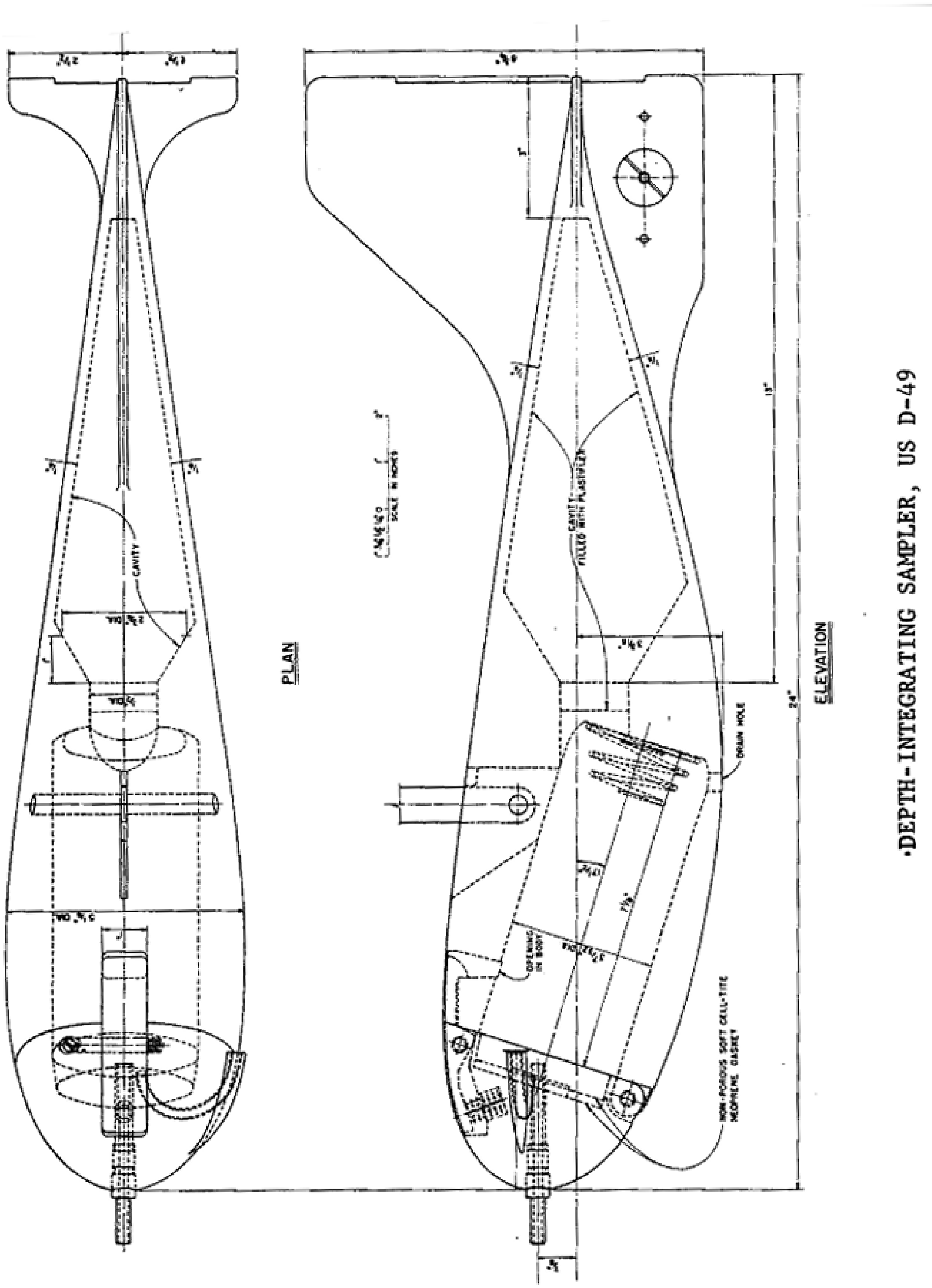
A portion of the exterior of the glass bottle may be etched or otherwise treated to provide a surface suitable for recording all the essential information for each sample.

Methods of analyzing sediment samplers are discussed in Reports Nos. 4, 7 and 11 of the series of reports on "A study of Methods Used in Measurement and Analysis of Sediment Loads in Streams," sponsored by the Subcommittee on Sedimentation, Inter-Agency Committee on Water Resources.

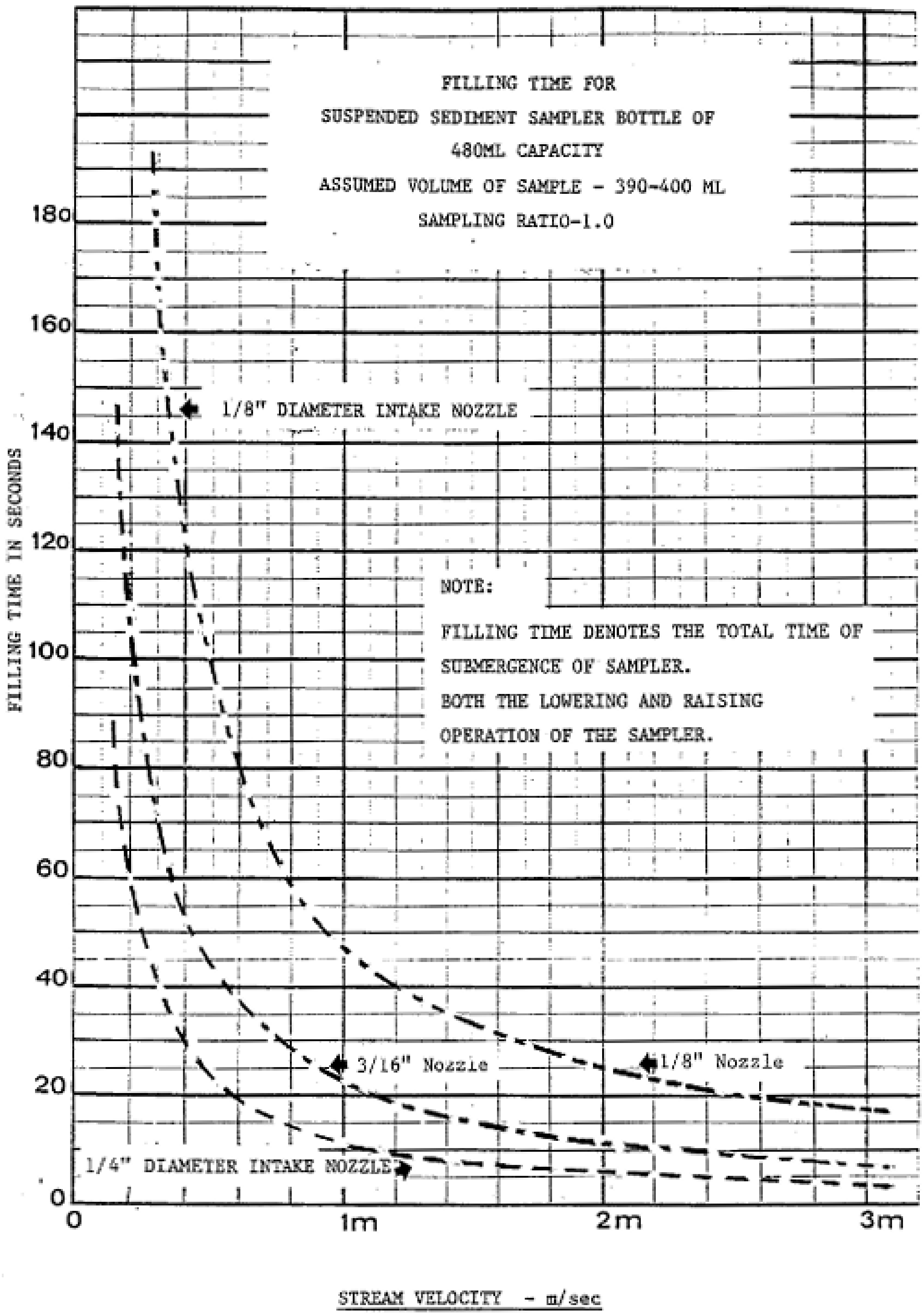
SPECIFICATIONS

Type:	Suspension
Materials:	Cast Bronze
Net Weight:	28kg (62lb)
Dimensions:	815 mm long
Max. Depth:	7.4 m
Max. Velocity:	2 m/sec
Min. Stream Velocity:	0.46 m/sec
Packing Details:	37kg, 0.03m3

SCHEMATIC


·DEPTH-INTEGRATING SAMPLER, US D-49
PLAN
ELEVATION
CAVITY
DRAIN HOLE
OPENING IN BODY
SCALE IN INCHES

FILLING CHART



REFERENCES

A large portion of this manual was obtained from the USGS website.

http://water.usgs.gov/owq/FieldManual/Chapter2-Archive/Archive/2.1.html

http://pubs.usgs.gov/twri/