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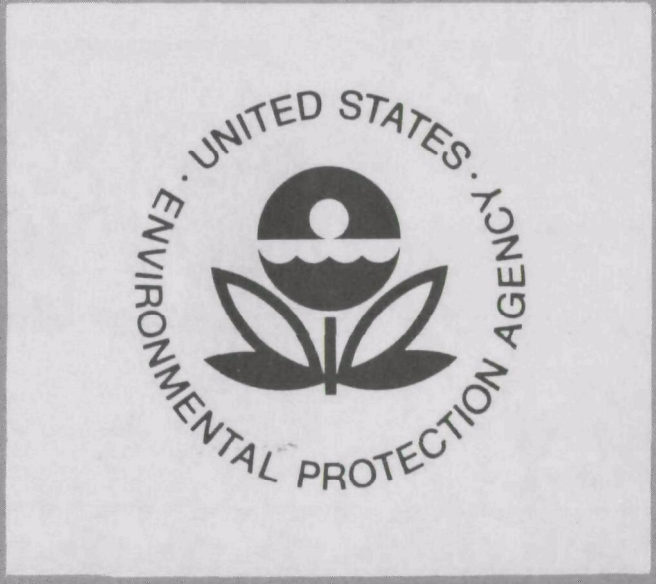
Environmental Monitoring Series

PROCEDURES FOR EVALUATING OPERATIONS OF WATER MONITORING NETWORKS



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PREFACE

The procedures detailed herein are a "first cut" at the development of a mathematical basis for the evaluation of monitoring network operations. Since the relative importance of the components of network operations is a function of monitoring network objectives, no single evaluation technique is universally applicable. For this reason and because of the complex nature of this subject, the evaluation methods developed herein are applicable only to monitoring networks whose main objective is to document compliance with or progress toward attainment of promulgated ambient water-quality standards and/or regulations.

A necessary restriction placed on development of this evaluation procedure was that it be consistent with existing regulations promulgated by the U.S. Environmental Protection Agency (EPA) concerning site selection, network design, sampling methodology and quality assurance procedures. Substantial changes in these regulations will require modification of the evaluation procedure.

Identification of the seven major operational components of a water-quality monitoring network with the stated main objective was accomplished by an on-site study of five networks judged by the EPA Regional Offices to be among the best operating networks. The major characteristics identified are: 1. Network Design, 2. Personnel, 3. Facilities and Equipment, 4. Sampling, 5. Quality Assurance, 6. Data Distribution and Dissemination, and 7. Agency Interactions. While the on-site studies served to identify the operational components, they did not provide sufficient data for a mathematical assignment of the relative weights for these components. To provide the latter, the opinions of governmental experts in the monitoring field were solicited and the results statistically analyzed. Values of the weighting factors so derived have been carried to the third decimal place because these factors are normalized values of over 40 responses. It will be noted, therefore, that users of these evaluation techniques will be comparing the operational characteristics of their network against mathematically derived functions of the opinions of over 40 experts. While this approach admittedly has drawbacks, it is, as stated, a "first cut" approach. A separate document describing the mathematical treatment of the expert opinion data and derivation of the relative weights of operational components will be furnished by the Project Officer upon request.

Finally, it will be noted that application of this procedure is complex and can be carried out only by personnel directly involved in operation of the monitoring network. Depending on the magnitude of the network, this application may require inputs from several individuals with a total manpower investment of up to 5 man-days. This latter, however, is a small price if it leads to a more technically optimum and cost-effective monitoring operation.

The procedures in this manual have not been field tested; however, such an evaluation is planned for the immediate future. In the interim we encourage users of this manual to submit their observations and suggestions for improvement.

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NOTICE TO USERS OF THE MANUAL

At the time this manual was prepared, the Code of Federal Regulations (CFR) Title 40, Part 130, required each State to prepare a "Basin Plan," as defined in the Glossary, in the quotation from 40 CFR 130, June 3, 1974. This "Basin Plan" was used as a basic unit in evaluation procedures used in the manual. During the time required for review and final preparation of the manual for publication, 40 CFR 130 was revised and terminology was changed. The term "Basin Plan" was deleted, and the replacing term "water quality management plan" is now used; the term "Basin" was deleted, and the terms "State planning area," "approved planning areas" and "designated area-wide planning area" are now defined and used in the current CFR revision dated November 28, 1975. The terminology used in the manual is familiar to potential users, and State Basin Plans are in existence; therefore, the older terminology has not been changed to that in the latest CFR revision. Following alphabetical definitions of the older terminology in the glossary, definitions of these new terms are quoted from the November 1975 revision of the CFR, so that correlation can be made between old and new terminology.

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LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

A.A. Spectrophotometer	atomic absorption spectrophotometer
Algal nut.	algal nutrients
Alkal/acid.	alkalinity/acidity
Avg.	average
Bact. param.	Bacteriological parameters
Engr.	Engineering
EPA	U.S. Environmental Protection Agency
freq.	frequency
I.R.	Infra-red
mfr.	manufacturer
mtls.	metals
PL	Public Law
Ref.	Reference
Refrig.	Refrigerator
Rel. R	Relative Rating
Spec. Cond.	Specific Conductance
Spectrophoto.	Spectrophotometer
SS	Suspended Solids
Stat. control	Statistical control
Std.	standard
Temp.	temperature
Turbid.	turbidity
USGS	U.S. Geological Survey
U.V.	ultra-violet
vol. anal.	volumetric analysis

SYMBOLS

COD	chemical oxygen demand
DO	dissolved oxygen
pH	the hydrogen-ion activity in gram equivalents per liter, used to express both acidity and alkalinity
STORET	symbol for the water quality data storage and retrieval system developed by and for the EPA
TKN	Total Kjeldahl nitrogen
TOC	Total organic carbon

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Many individuals at the five water networks visited and the respondents to the Letter Survey have been helpful in developing the material used in these recommended procedures. For all assistance received from them and from the members of the URS in-house panel of experts, the project management extends its sincere gratitude.

Mr. Edward Schuck, U.S. Environmental Protection Agency, served as Project Officer, assisted by Mr. Leslie Dunn and Mr. Les McMillion. Mrs. Ruth Shnider served as Project Manager, Dr. Wesley Bradford visited and compiled the information on the five networks studied, and Dr. Edwin Shapiro developed the theory and prepared the material for Sections III and XI.

SECTION I

INTRODUCTION

This manual presents procedures for performing an evaluation of the major factors affecting the efficiency and effectiveness of an existing surface-water quality monitoring and standards compliance network. Two basic simplifications are used: (1) the assumption that the primary purpose of water quality monitoring is to document progress toward attaining, or the maintenance of, both ambient and discharge water quality objectives; (2) only the primary network is considered in the evaluation scheme. This fixed network must meet a wide range of long-term objectives and is operated by that organization with the responsibility for monitoring water quality and compliance in the area. Many organizations (federal, state, private) may operate monitoring stations within any given network area. Stations from which data effectively contribute to the knowledge of the responsible organization may be considered a part of the primary network system, even though that organization does not bear their cost. Stations that are ineffective in aiding the responsible organization to meet water quality objectives are not considered part of the network.

The evaluational techniques presented in this manual are achieved by subdividing network operations into a set of Areas such as Plan and Design, Personnel Qualifications, Facilities and Equipment, and Quality Assurance. Each Area is evaluated individually, based on rating major Elements that comprise the functions of the Area and influence the effectiveness of output. Each Area evaluation cannot -- and does not attempt to -- deal with all the complexities involved, since such an effort would be extremely lengthy and time-consuming. However, evaluational results are meaningful because the techniques used should make apparent any significant deficiency in an Area or an Area Element, and indicate the need for an in-depth detailed examination. For each Area, a method is provided for integrating the Element ratings into an Area Evaluation. Similarly, a method is provided for the integration of Area evaluations, resulting in an overall network evaluation.

The final section of the manual presents an analysis of the cost-effectiveness of network operations, based on information available at this time. Adjustments in the analytical results can readily be made if more information is made available.

The procedures presented for evaluation of network design are based on the assumption that the State Basin Plan is designed to meet defined water quality objectives, and that it locates and lists all significant discharges, characterized by parameters; locates all monitoring stations, both existing and planned, along with parameters monitored at each;

lists and maps each segment; and classifies each. These requirements are all stated in the Federal Water Pollution Control Act (PL 92-500), 1972, and in the Code of Federal Regulations, (CFR), Title 40, Parts 130 and 131, 1974. Recommended evaluation techniques also consider that monitoring requirements are a function of parameters that affect water quality, and the major parameters vary with regional characteristics, activities, and/or land use. In an initial effort to develop a systematic approach to such requirements, six basic land-use types of areas are defined, with a set of parameters proposed as indicators of water quality for each area. Any one or any combination of these types of areas may be encompassed by the network. It is suggested that one measure of network efficiency is the degree to which these parameters are monitored in the receiving waters for each area-type. Proposed basic areas and indicator parameters for the receiving waters of each area are:

A. Cities with heavy industry, commerce, and high population density, that create the major waste burden for the receiving waters.

   Major parameters: DO, pH, Turbidity/Suspended Solids, Biota/Species Diversity, Bacteriological Parameters, Trace Metals.

B. Urban/Suburban areas, where the major discharge to the receiving waters is domestic sewage and runoff from residential areas.

   Major parameters: DO, Algal Nutrients, Turbidity, and where recreational areas are included, Bacteriological Parameters.

C. Watersheds/Wilderness areas, where surface water quality is essentially unaltered, i.e., the impact of human activity and/or land development has not significantly changed the natural condition of surface waters.

   Major parameters: DO, Algal Nutrients, Temperature, Trace Metals if the areas include metallic deposits, as most such areas do.

D. Farming areas, where the water quality is dominated by agricultural drainage.

   Major parameters: DO, Algal Nutrients, Bacteriological Parameters, Turbidity/Suspended Solids.

E. Eutrophic or Potentially Eutrophic areas, where water quality is rapidly degrading.

   Major parameters: Algal Nutrients (including TOC), DO, Turbidity, Temperature.

F. Mining areas and areas of geothermal activity, where the natural conditions of the surface waters are affected by leachate or runoff from mines.

Major parameters: Trace Metals, Toxic Materials, pH, Alkalinity/Acidity, Turbidity/Suspended Solids, Specific Conductance.

The indicator parameters for each area may require modification as a result of the regional characteristics with respect to rainfall, i.e., whether the region is one of average or normal rainfall, or whether it is arid. Major indicator parameters for an arid region should be included with those of the specific area if it lies in an arid region, defined as one where water consumption within the area consistently exceeds net annual precipitation and necessitates reuse of water. Parameters particularly affecting water quality are: pH, Alkalinity, Algal Nutrients, Specific Conductance, Bacteriological Parameters. Table 1 presents a tabulated summary of the six Areas and Indicator Parameters.

The operations of the existing network are evaluated, in this proposed methodology, with respect to several factors: (1) the State Basin Plan; (2) recommendations in the U.S. Environmental Protection Agency (EPA) document Model State Water Monitoring Program, June 1973; (3) area type and representative or critical locations for monitoring indicator parameters; and (4) requirements as indicated in a nationwide survey of qualified personnel involved in water quality monitoring.

Reference standards used in evaluating facilities, equipment, and quality assurance are taken from the U.S. EPA, Handbook for Analytical Quality Control in Water and Wastewater Laboratories, 1972; U.S. EPA, Methods for Chemical Analysis of Water and Wastes, 1974; U.S. EPA, Biological Field and Laboratory Methods, 1973; U.S. EPA, Model State Water Monitoring Program, June 1975; and pertinent published Federal regulations. Weighting factors used in some evaluations are derived from analysis of the weightings given the various Elements and their components in the nationwide survey noted earlier.

To carry out the recommended procedures for evaluation, a map of the network showing existing station locations and the State Basin Plan for the area in which the network is located will be needed. It would also be valuable to have at hand the first four reports noted in the preceding paragraph, fully documented in the list of References.

The manual consists of the next ten Sections numbered with Roman numerals. Section II is the Compilation of the Data Base, to be recorded in Tables 2 through 6. Table 2 concerns general network information on participating agencies, station locations, and parameters monitored at each; Table 3 concerns personnel qualifications; Table 4 deals with facilities, equipment and standards; Table 5 concerns data dissemination and utilization; and Table 6 requires information on budgetary allocations. Some information should be available from files of the network and some from the Basin Plan;

TABLE 1. SUMMARY OF INDICATOR PARAMETERS FOR SIX AREA TYPES IN REGIONS OF AVERAGE RAINFALL AND FOR AN ARID REGION

Municipal/Industrial	Urban/Suburban	Watershed/Wilderness
DO	DO	DO
Bacteriological Parameters	Algal Nutrients	Algal Nutrients
Turbidity/Suspended Solids	Bacteriological Parameters	Temperature
pH	Turbidity	Trace Metals
Biota/Species Diversity		
Trace Metals		
Farming	**Eutrophic or Potentially**	**Mining/Geothermal**
DO	DO	pH
Algal Nutrients	Algal Nutrients	Turbidity/Suspended Solids
Bacteriological Parameters	Turbidity	Specific Conductance
Turbidity/Suspended Solids	Temperature	Alkalinity/Acidity
		Trace Metals
		Toxic Materials
	Arid Region	
	Algal Nutrients	
	Bacteriological Parameters	
	pH	
	Specific Conductance	
	Alkalinity	

personal inspection will be required for some data. When Section II is completed, the evaluation procedures of each of the following Sections can be completed in a short time. The entire task, including Section II, should take no more than 5 days.

A Glossary is located at the end of the manual to ensure uniformity of meaning of the terminology used.

SECTION II

COMPILATION OF THE DATA BASE

In this Section, the information needed to carry out the evaluational procedures for each Area considered will be tabulated in Tables 2 through 6.

II.A INFORMATION ON PRIMARY NETWORK DESIGN AND PARAMETERS MONITORED

Source Information: Network Map and Basin Plan
Tabulation of Data: Table 2

In Table 2, information is to be recorded on the number of stations in each of a number of categories. "Categories" are activity-monitoring locations, for which parameters requiring monitoring can be correlated with Area Indicator parameters, defined in the Introduction. Additional information to be recorded concerns: (1) whether stations are located in regions that are arid, or of average rainfall; (2) the parameters monitored; and (3) the frequency of sampling.

The determination and recording of such information for all stations of a network would provide information for a complete evaluation of the network design and of the network monitoring effectiveness, but the task could be prohibitively time-consuming. To avoid such a situation, inspect the station categories listed in Table 2, and select, for broadest application, one segment or subbasin in the network that includes the maximum number of such categories. Record information in Table 2 for this one segment, and use it as representative of the network. Note that stations located in bays or estuaries do not form a category, but should be included in a downstream group of the category that evaluates effects on the receiving waters of activities applicable to the particular situation.

A critically located station will usually provide extremely valuable information because it will monitor effects on water quality of more than one activity, and thus serve in a cost-effective way. Therefore, in the tabulation of Table 2 list each station in every category for which it is used. For instance, the upstream receiving water station of a pair bracketing a municipal and industrial center may at the same time monitor the receiving waters downstream of irrigated farmland. Such a station should therefore be counted in categories 5.a and 13.b. However, the Region type of the activity being monitored may differ, and the parameters monitored may also differ in the two categories, and should be so indicated.

As noted above, the network map and Basin Plan should provide the information needed to complete Table 2, the format of which has been designed to allow rapid retrieval of information for use in the evaluations of several

Table 2. PRIMARY NETWORK INFORMATION

A. STATIONS, LOCATIONS, PARAMETERS, AND MONITORING FREQUENCY

1. Number of significant point source discharges in selected representative segment or subbasin _________
2. Total number of stations in segment _________
3. Number of effectively contributing fixed stations in the selected segment per Agency _____ _____ _____ _____ _____ Number of existing plus planned per Agency _____ _____ _____ _____ _____

STATION CATEGORY	NUMBER OF STATIONS: E*		P*		Parameters and Sampling Frequency monitored at existing stations																																												
	Region type		Region type		DO			Algal nutrients			Spec. cond./SS			pH			Alkal/acid.			Temp.			Trace metals toxic mtls.			COD			TOC			Bacter. param.			Turbid./SS			Biota/species diversity**			Stream flow			Stage of water surface elev.			Tidal stage		
	Arid	Avg.	Arid	Avg.	N‡	S§	F‖	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F	N	S	F
4. No. stations in receiving waters bracketing significant point source discharges†: (a) upstream																																																	
(b) downstream																																																	
5. No. stations monitoring receiving waters of municipal and industrial centers: (a) upstream																																																	
(b) downstream																																																	
6. No. stations monitoring receiving waters or urban/suburban areas: (a) upstream																																																	
(b) downstream																																																	
7. No. stations at drinking water supply intakes.																																																	
8. No. stations at reservoirs:																																																	
9. No. stations in recreational water bodies:																																																	
10. No. watershed/wilderness area stations: (a) upstream																																																	
(b) downstream																																																	
11. No. stations monitoring eutrophic or potential eutrophic water bodies:																																																	
12. No. stations at mouths of significant tributaries to mainstem rivers or bays:																																																	
13. No. stations monitoring receiving waters of irrigated farm land. (a) upstream																																																	
(b) downstream																																																	
14. No. stations monitoring receiving waters from mining or geothermal areas: (a) upstream																																																	
(b) downstream																																																	
15. No. upstream boundary stations																																																	
16. No. downstream boundary stations																																																	
17. Representative location in rivers, coastal areas, impoundments																																																	
18. Total Activities Monitored																																																	

* E = Existing stations
P = Planned stations

† As you record number per Region type, indicate also the number of discharge points (D) that are monitored, i.e., 4/6D or 3/3D.

‡ No. stations monitoring the parameter by Region type, i.e., 3/n, or 5/a.

§ Sampling; code A for automatic code M for manual

‖ F = frequency; code the frequency representative of most stations in category:
D = daily BM = bimonthly SY = semiannually
W = weekly Q = quarterly (seasonally) C = continuously
M = monthly Y = annually T = three times/yr.

Also note any State or local requirements

** Record plankton separately from other biological parameters:

p/
b/

network operational Areas. Each item is numbered. These numbers will be used as "Source Reference" identifiers in the evaluation tables. For uniformity of format, there is a column for S, Kind of Sampling, below each parameter, although only Manual Sampling applies for some parameters.

To proceed with the compilation of the data base, determine and indicate on the network map those areas of the selected segment that are of average rainfall, and those that are arid (if there are differences to be noted in Table 2). Then record in Table 2, as indicated in the following Procedural Steps, data that pertain to the selected segment.

Step 1

From the Basin Plan, determine the number of "significant" (as defined in the Glossary) point-source discharges in the segment, and record the number in Table 2, item 1.

Step 2

Record in item 2 the total number of fixed stations in the segment, regardless of whether the stations contribute to primary network information.

> (In the following Steps, include only stations that contribute effectively to the primary network information, and are located in the receiving waters.)

Step 3

Record in item 3 the number of Existing fixed stations, per Agency, e.g., 8/local, 3/State, 2/USGS, 2/EPA, etc. Similarly record the total Planned (existing plus those to be added, per Agency), according to the Basin Plan.

Step 4

Use the network map and the Basin Plan to determine the information needed in item 4. Record the number, per Region type, of stations monitoring effects of point-source discharges, both Existing (in column labeled E) and Planned (column labeled P) stations upstream of the discharges in item 4.a, and downstream, item 4.b. For each number of stations, also record the number of discharge points (D) monitored, e.g., 4/6D, 3/3D, etc.

Step 5

For each group of stations (upstream and downstream) listed in Step 4, record the following: (1) number of stations monitoring each parameter listed -- if both Region types are checked within one group, indicate the number of stations by Region type for each parameter, using "n" to indicate average rainfall and "a" to indicate arid, e.g., 3/n, 2/a; (2) the kind of sampling (automatic or manual); (3) code the frequency as indicated on the Table. If, within a group, the frequency varies, record that most typical.

Step 6

Follow the procedures of Steps 4 and 5 for each of the listed categories (items 5 through 17) that are applicable to the segment. Regarding item 17, the definition of Representative Point" is provided in the Glossary.

Step 7

When all the stations are listed, by category and Region type, through item 17, sum the totals for each Region type. For categories 4.a and 4.b, count the number of discharge points monitored, rather than the number of stations. Record the totals for each Region type in item 18. These totals provide an accounting of the number of activities monitored in the segment, by Region type.

II.B INFORMATION ON PERSONNEL

Source of information: Personnel Files
Tabulation of Data: Table 3

In Table 3, the first column lists general categories of network technical positions. The specific positions may vary with networks. Fill in the applicable positions, and the remaining information needed in the table.

TABLE 3. PERSONNEL INFORMATION

1. Position and section	2. Years in present position	3. Starting position (if other than present)	4. Salary of starting position today	5. Salary today	6. Years with network	7. On-job training* availability
Administration						
Water monitoring						
Laboratory						
Data analysis						
Compliance-engr.						

*Courses made available by the network.

II.C INFORMATION ON FACILITIES, EQUIPMENT, AND STANDARDS

Source of Information: Inspection of facilities, laboratory procedures, records, and discussions with monitoring and laboratory supervisory personnel.

Tabulation of Data: Table 4

There are seven sections in Table 4, each of which consists of a series of questions with space provided for the answers. Non-metric units of square feet are used in this text as referenced in the source materials used. The conversion factor is sq. ft. x 0.0929 = m^2. All the information requested will be used in the evaluations. Much of the information regards laboratory equipment and procedures. If the network does not operate its own laboratory, determine the information regarding the laboratory that performs analyses for the network.

TABLE 4. INFORMATION ON FACILITIES, EQUIPMENT, AND STANDARDS

1. Office Facilities

   a. What is the percentage of office personnel with a minimum of 100 sq. ft. per person ? _____%
   b. Are appropriate reference sources available, either in a library or on Division bookcases? _____

2. Laboratory Facilities and Equipment

   a. Space

      (1) What is the percentage of laboratory personnel with a minimum of 150 sq. ft. per person? _____%
      (2) Is there sufficient bench-top space to provide for permanent setup of equipment, glassware, reagents, etc.? _____
      (3) Is hood space adequate? _____
      (4) Are drawers available for keeping items in an orderly fashion? _____
      (5) Is there a separate locked area for enforcement samples? _____

   b. Cleanliness

      (1) Is a check list maintained to assure area cleanliness? _____
      (2) Is a check list maintained to assure hood cleanliness? _____
      (3) Are safety showers available? _____
      (4) Are exits free of debris, etc.? _____

TABLE 4. (continued)

c. Environmental control

(1) Is there separate refrigerator/freezer space for sample storage? _____
(2) Is a separate area provided for dark, dry storage? _____
(3) Are stock reference materials stored in a separate cold area? _____
(4) Are hoods on independent exhaust systems? _____
(5) Are all hoods in working order? _____

d. Equipment

(1) If at least two units of permanent glassware set ups (e.g., for titrations, COD, TKN, etc.) are available, record a value of 1; if only one setup is available, record 0.5. _____
(2) What percentage of calibrated volumetric glassware is of borosilicate glass, Class A designation? _____%
What is approximate total number of volumetric glass containers? _____
(3) What percentage of plastic vessels or containers is of Teflon, polyprolylene, or high density polyethylene? ___%
What is the approximate total number of plastic containers? _____
(4) What is average age of equipment?
1 to 3 years _____,
3 to 6 years _____,
6 to 10 years _____
(5) Express as a decimal number the number of the six standard porosities of fritted ware that are available. _____
(6) Is fritted ware properly stored and classified? _____
(7) If each of the following is available, record a 1, if not, a zero:
(a) incubator _____;
(b) still _____;
(c) ovens _____;
(d) water baths _____;
(e) recorders _____;
(f) NBS-certified thermometer _____;
(g) compressed air _____;
(h) constant voltage supply _____;
(i) selective ion electrodes _____.

e. Supplies (chemicals, reagents, gases)

(1) Are supplies appropriately stored? _____
(2) Are supplies appropriately handled? _____
(3) Are standard reference materials used? _____
(4) Is an inventory maintained? _____
(5) Are established purchasing guidelines used? _____
(6) Are chemicals dated on receipt of shipment? _____

TABLE 4. (continued)

3. Laboratory Instruments and Maintenance

a. If each of the following instruments is available, record a 1, if not, a 0.

(1) Both gross and fine analytical balances _____
(2) Potentiometer (pH meter) _____
(3) Conductivity meter _____
(4) Turbidimeter _____
(5) Visual spectrophotometer _____
(6) Ultraviolet spectrophotometer _____
(7) Infrared spectrophotometer _____
(8) Atomic absorption spectrophotometer _____
(9) Total carbon analyzer _____
(10) Gas chromatograph _____

b. Instrument specifications

(1) Are analytical balances of appropriate sensitivities and proper mountings for tests performed (as defined in the EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories)? _____
(2) Are pH meters available with both normal and expanded scales? _____
(3) Is the Turbidimeter used the Hach Model 2100A or equivalent? _____
(4) Are the sensitivity and precision of the laboratory instruments sufficient to measure all necessary parameters as specified in the EPA manual, Methods for Chemical Analysis of Water and Wastes? _____

c. Instrumental and analytical method calibrations

(1) Are there documented calibration schedules for all instruments? _____
(2) Are these schedules according to Manufacturer's recommendations? _____
(3) Has documentation been used to modify the schedule? _____
(4) Are balances serviced at least once per year? _____
(5) Are Class S weights available for periodic checks on balances? _____
(6) Are these checks documented? _____
(7) Are color standards or their equivalent used to verify wavelength settings of spectrophotometers? _____
(8) Are these results documented? _____
(9) Are volumetric analyses checked against primary standards? _____

TABLE 4. (continued)

4. Field Facilities, Instruments, and Maintenance

a. Facilities:

(1) What is the percentage of stations with permanent housing? ____%
(2) Is there at least one fully equipped mobile laboratory per Basin? _____
(3) Is there at least one portable equipment vehicle per Basin? ____
(4) Are portable refrigerated containers always available? ____

b. Field instruments

If the following portable field instruments are always available, record a 1, if not, a 0.

(1) pH meters _____
(2) Conductivity meters _____
(3) DO meters _____
(4) Portable wet analytical gear _____

c. Fixed monitors

(1) At what percent of the stations are there fixed monitors? _____%

d. Calibration of field instruments

(1) Are calibrations documented at beginning and end of each day's use for all meters used for field measurements? _____
(2) Are fixed continuous sensor calibrations checked and documented at least weekly? _____
(3) Are calibration frequencies checked against manufacturer's recommendations? _____
(4) Is documentation used to modify calibration schedule? _____

e. Maintenance of field instruments

(1) Is regular maintenance on a documented schedule? _____
(2) Is documented maintenance used to modify the schedule? _____
(3) Is the schedule compared with manufacturer's recommendations? _____

f. Controls on field measurements

(1) Is instrument down time documented and evaluated? _____
(2) Is transmitted data validated? _____
(3) Are secondary standards validated? _____
(4) Is there a preventative maintenance schedule? _____
(5) Are statistical control chart techniques used? _____

TABLE 4. (continued)

5. Analytical Measurement Controls

a. Sample containers, preservation techniques, and holding times

(1) Is glass used for all organic analyses? _____
(2) Are preservation techniques those cited in Methods for Chemical Analysis of Water and Wastewater (Ref. 2)? _____
(3) If techniques other than those of Ref. 2 are used, are data on a variety of sample types provided to document use of the techniques? _____
(4) Are holding times those cited in Ref. 2? _____
(5) If other than Ref. 2 holding times are used, are data cited on a variety of sample types to document the use? _____
(6) Are volumes of samples sufficient for all needed/desired analyses? _____

b. Analytical methods used

(1) Do analyses use procedures in recognized manuals such as EPA, GS, SM, ASTM, and/or those published in scientific journals? _____
(2) Is each method written up and on file for review? _____
(3) Are test procedures for compliance monitoring those defined in 40 CFR 136? _____
(4) Are statistical control chart techniques used? _____

c. Cleaning methods

(1) Standard cleaning methods (for glassware and equipment) are followed, adapted to analyses to be performed, _____% of the time;
(2) Special cleaning requirements (for spectrophotometers, trace metals, organic analyses) are followed _____% of the time;
(3) Filters are cleaned by standard methods _____% of the time.

d. Validation techniques

(1) How many replicate analyses are performed to every set or to approximately every 20 samples? _____
(2) Is use made of (a) blind samples _____; (b) split samples _____; (c) spiking samples in field at times of collection _____?
(3) How many spiked samples are run to approximately every 20 samples? _____
(4) Is there an on-going interlaboratory comparison program? _____

6. Documentation

a. Is a documented check list maintained on:

(1) Compressed air purity? _____
(2) Distilled water purity? _____

TABLE 4. (continued)

(3) Deionized water purity? _____
(4) Vacuum system freedom of impurities? _____
(5) Reagent and solvent preparation and standards? _____

b. Are corrections of bench records crossed out, not erased? _____
c. What percent of data records are dated and signed? _____
d. Is a written chain-of-custody procedure available and in use? _____
e. What percent of analyses are recorded in permanent form? _____
f. What is the form: (a) unbound sheets _____;
(b) bound notebooks _____.
g. Are samples identified by number? _____
h. Are all samples logged in? _____

7. Specified Quality Assurance Program

a. Is there a written quality assurance program? _____
b. Has a Quality Assurance Officer, or equivalent, been appointed, and is required training being provided? _____
c. What finite percentage of monitoring resources is formally committed to quality assurance and related activities? _____

II.D INFORMATION ON DATA DISSEMINATION AND UTILIZATION

Determine from office files and discussion with personnel, answers to the questions of Table 5, and record the results in the Table.

TABLE 5. DATA DISSEMINATION AND UTILIZATION

1.	What is average data turnaround time, i.e., time from data analysis until it is available to a user?	_____
2.	Are data supplied to STORET?	_____
3.	Are water quality data released to the public at least annually?	_____
4.	Are the data used to develop and/or support models?	_____
5.	Do data support enforcement actions if needed?	_____
6.	Does data flow routinely to the next higher Agency? (i.e., if local to State, if State to U.S. EPA)	_____

II.E INFORMATION ON BUDGETARY ALLOCATIONS

Office files should contain needed information on budget allocations to be recorded in Table 6.

TABLE 6. INFORMATION ON BUDGETARY ALLOCATIONS

Water monitoring agency _____ Number basins in network _____

Indicate whether major emphasis is: Water quality monitoring _____

Compliance _____

A. Budget information

1. Total budget $_____

		Technical Services		
	Administration and public information	Water quality monitoring	Lab and data analysis	Compliance
2. Budget for activity	$_____	$_____	$_____	$_____
3. Percent of total	_____%	_____%	_____%	_____%
Personnel				
4. Salaries and Benefits	$_____	$_____	$_____	$_____
5. Percent of activity budget (2)	_____%	_____%	_____%	_____%
6. Percent of total budget (1)	_____%	_____%	_____%	_____%

7. Total personnel budget $_____

8. Percent of total budget _____%

SECTION III

AREA OF NETWORK PLAN AND DESIGN

In this Area, ratings are carried out only for two Elements -- the number of stations in the selected segment and station location. The latter was definitely weighted the most important factor among the experts queried in the Letter Survey. Site characteristics were considered next in importance, for obvious reasons. Poor quality of certain Site Characteristics, such as Site Accessibility, ease of access to the water, and design of fixed instrumentation could affect quality control (of prime importance since that affects data validity) and sampling frequency. However, not only can quality definition of these three items be subject to personal bias, but also the compilation of information needed to determine the quality (including actually visiting the sites) could be too lengthy a task to fit the constraints of gathering data and performing the planned network evaluation within five days. Therefore, only the two Elements are considered in this Area. A Rating is derived for the number of Stations, first.

III.A RATING OF NUMBER OF FIXED STATIONS

This Element is divided into two sub-Elements, scored separately. The scores are then combined to derive the Element rating.

III.A.1 Stations by Category

For this evaluation, the number of stations monitoring each category is given a score, using the State Basin Plan as the reference standard.

The methods for the first two scores are detailed to clarify the procedure. The remaining ones are listed in order. Procedures are stated in "Steps," with corresponding "Steps" indicated in Table 7, along with the Source Reference (items in Table 2). All information needed is recorded in Table 2. Fill in only those Procedural Steps for which categories are applicable in the selected segment.

Step 1

a. Record on the first line of Table 7, in the column labeled "No. E," the number of existing stations for all Region types, upstream of discharges (sum the numbers for item 4.a, column E).

b. Record on the same line in the column labeled "No. P," the total number of Planned stations monitoring upstream (sum the item 4.a numbers in column P).

TABLE 7. RATING OF EXISTING STATIONS BY CATEGORY

E = number of Existing Stations, per category, items 4 through 17, Table 2.

P = total number of Planned Stations per category, items 4 through 17, Table 2.

Score = No. E divided by No. P.

	Source ref. Table 2	No. E	No. P	Score
	Item			
Step 1.	4.a			
Step 2.	4.b			
Step 3.	5.a			
Step 4.	5.b			
Step 5.	6.a			
Step 6.	6.b			
Step 7.	7.			
Step 8.	8.			
Step 9	9.			
Step 10.	10.a			
Step 11.	10.b			
Step 12.	11.			
Step 13.	12			
Step 14.	13.a			
Step 15.	13.b			
Step 16.	14.a			
Step 17.	14.b			
Step 18.	15			
Step 19.	16			
Step 20.	17			
Step 21.			Sum =	
Step 22.			Sub-Element rating r_1 =	

NOTE: The closer the value of r_1 is to 1, the closer the number of stations is to the required number.

c. In the column labeled "Score," record as a decimal number the value of No. E divided by No. P. This number provides a score, when expressed as a percent, of the number of existing stations monitoring upstream of point source discharges with respect to the Basin Plan number of stations.

Step 2

a. Record on the second line of Table 7, in the column labeled No. E, the number of existing stations for all Region types (sum the numbers in item 4.b, column E, Table 2) monitoring downstream of point source discharges.

b. Record on the same line, in the column labeled No. P, the total number of Planned stations monitoring downstream of point source discharges (sum the numbers in item 4.b, column P, Table 2).

c. In the column labeled score, record as a decimal number the value of No. E divided by No. P. This number, expressed as a percent, expresses the degree to which the existing number of stations monitoring downstream of point source discharges meets requirements of the Basin Plan.

Steps 3 through 20 are a repetitive operation of Steps 1 and 2 for the following inputs:

Step 3

The number of stations monitoring the waters upstream of municipal and industrial centers;

Step 4

The number of stations monitoring downstream of municipal and industrial centers;

Step 5

The number of stations monitoring upstream of urban/suburban areas;

Step 6

The number of stations monitoring downstream of urban/suburban areas;

Step 7

The number of stations monitoring water-supply intakes;

Step 8

The number of stations monitoring reservoirs;

Step 9

The number of stations monitoring recreational water bodies;

Step 10

The number of stations monitoring upstream of watershed/wilderness areas;

Step 11

The number of stations monitoring downstream of watershed/wilderness areas;

Step 12

The number of stations monitoring eutrophic or potentially eutrophic water bodies;

Step 13

The number of stations at mouths of significant tributaries to mainstem rivers or bays;

Step 14

The number of stations monitoring upstream of irrigated farmland;

Step 15

The number of stations monitoring downstream of irrigated farmland;

Step 16

The number of stations monitoring upstream of mining or geothermal areas;

Step 17

The number of stations monitoring downstream of mining or geothermal areas;

Step 18

The number of upstream boundary stations;

Step 19

The number of downstream boundary stations;

Step 20

The number of stations in representative locations in rivers, coastal areas, impoundments;

Step 21

Sum the scores for all categories of stations for which number of stations

was scored, and record the number in Table 7.

Step 22

Divide the sum of Step 21 by the number of categories evaluated, and record the value in Table 7. This decimal, expressed as percent, provides an overall rating r_1, for the sub-Element, the Number of Stations by category in the Primary network segments. If the segment is representative of the network, this will serve as a network rating.

III.A.2 Rating of Stations Monitoring Point Source Discharges

Monitoring receiving waters above and below point source discharges serves as a check on the Permit monitoring in the effluent streams, and is a necessary function for compliance and enforcement. A rapid evaluation of such monitoring is detailed in the following seven Procedural Steps. Table 8 is provided for recording, and the Source Reference items in Table 2 are noted for each Step in the Table.

Step 1

Record the total number of point source discharges in the segment.

Step 2

Sum and record the number of discharges (D) monitored upstream (see footnote to item 4, Table 2).

Step 3

Divide the number recorded in Step 2 by the number in Step 1, and record the answer in the score column.

Step 4

Sum and then record the number of point source discharges monitored downstream.

Step 5

Divide the number in Step 4 by the number in Step 1, and record the answer in the score column.

Step 6

Sum the two scores.

Step 7

Divide the sum by 2 to obtain the value of r_2, the rating of the sub-Element, Point Source Discharge Monitoring in the segment. Since this segment

was selected as representative of the network, the rating (where 1 is the optimal value) should also be representative of the network.

If the value of Step 7 is 1, the monitoring with respect to point source discharges is optimal. The percentage less than 1 indicates the percentage of point source discharges that are not being monitored.

TABLE 8. RATING OF STATIONS MONITORING POINT SOURCE DISCHARGES

Steps	Source Ref. Table 2 Item	Number of Point Discharges	Number Monitored	Score
Step 1.	1.			
Step 2.	4.a			
Step 3.	---	Step 2/Step 1	=	
Step 4.	4.b			
Step 5.		Step 4/Step 1	=	
Step 6	Sum score Step 3 + score Step 5 =			
Step 7	Sub-Element rating r_2 = Step 6/2 =			

III.A.3 Rating for the Element

Calculate R_1, the rating for this Element by summing the following two products:

From Table 7, record the value of r_1 _____ x (.80) = _____.

From Table 8, record the value of r_2 _____ x (.20) = _____.

Element Rating = R_1 = _____.

III.B RATING OF EFFECTIVENESS OF STATION LOCATION

The rating of the effectiveness of station location is actually based on cost-effectiveness. It is assumed that each station is properly located to monitor effects on the receiving waters of those activities designated for the station to monitor. In this element, the number of stations in the primary network segment is compared with the number of activities

monitored, to determine the ratio. In general, station locations are considered effective if the number of activities monitored is greater than the number of stations.

There may be exceptions to the general definition of an effective station location, due to specific regional problems that may require more than one station to monitor effects of only one activity. Such stations are usually part of the secondary network. If such conditions exist in the segment chosen for evaluation, and if the stations are considered part of the primary network, the Rating of this element does not change, but the condition should be noted for special consideration.

The procedures are listed as Steps, with Table 9 for recording values of items in Source Reference Table 2. Figure 1 is provided for the evaluation.

Procedural Steps

Step 1

Record in Table 9 the sum of the existing effectively contributing stations in the segment. (They are listed by Agency, but record the total number, item 3.)

Step 2

Sum the existing totals for the two Region types in item 18, and record that number as "Total Activities" in Table 9.

Step 3

Divide the total of Step 2 by the value of Step 1, and record the value as the score.

TABLE 9. SCORE FOR EFFECTIVENESS OF STATION LOCATIONS

	Source Ref. table 2. item	Number of stations	Total activities	Score
Step 1	3			
Step 2	18			
Step 3 (Step 2/Step 1)	--			

Step 4

Locate the score for Station Location on the horizontal axis of Figure 1, locate the intersection of that value on the plot, read the Element Rating on the vertical axis, and record it.

R_2 = Element Rating = _____.

The closer the Element Rating value is to 1, the more cost-effective are the station locations.

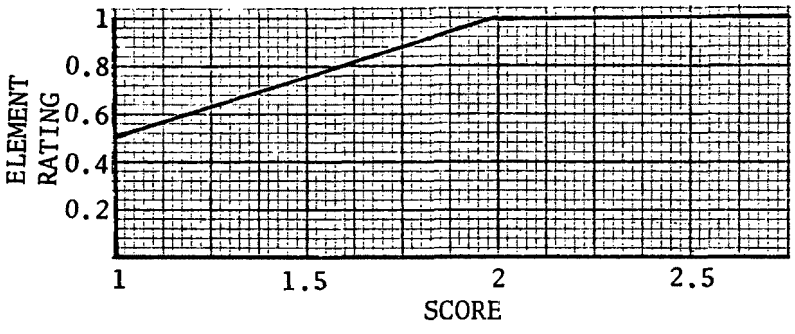


Figure 1. Rating for station location

III.C EVALUATION OF AREA OF PLAN AND DESIGN

The Evaluation of this Area is derived by summing the weighted Ratings of both Elements.

From Section III.A.3, R_1 = Rating for number of Stations _____

Then $R_A = R_1 \times (.386)$ = _____.

From Section III.B, R_2 = Rating for Station Effectiveness = _____

Then $R_B = R_2 \times (.614)$ = _____.

Area Evaluation = $R_A + R_B$ = _____.

The optimal area evaluation is 1.

SECTION IV

EVALUATION OF PERSONNEL

In this Section, two Elements are Rated: (1) Optimal Budgetary Allocations to Administrative and non-Administrative Personnel; (2) Technical Services Personnel Qualifications. The two Element ratings are then weighted using factors derived from the Letter Survey, and combined to provide an Area Evaluation.

IV.A BUDGETARY ALLOCATIONS

In this Element, the Rating is derived from information in Table 6 and from Figures 2 and 3. The procedure is described in the following Steps.

Procedural Steps

Step 1

From Table 6, item 7, the Total Network Personnel Budget = _____.

Step 2

From Table 6, item 2, the Total Technical Services Budget = _____.
(Sum of Monitoring + Lab & Data Analysis + Compliance)

Step 3

The value of Step 1 divided by Step 2 = _____.

Step 4

From Table 6, record the value of item 6 for Administration and Public Information = _____.

Step 5

Locate the point on Figure 2 that represents the value determined in Step 3 along the horizontal axis and the value in Step 4 along the vertical axis.

Step 6

If the point determined in Step 5 is in the shaded region of Figure 2, record in Step 13 the value 1 as the Budgetary Allocation Rating, and proceed to Section B. If the point is in the unshaded area, (above Curve A) proceed to Step 7.

Figure 2. Determination of administrative personnel budget allocation

Step 7

If the point located in Step 5 is not in the shaded region of Figure 2 (i.e., it is above curve A), determine the value on the vertical axis of the location on Curve A immediately below the point, and record the value _____.

Step 8

Record the value of item 8, Table 6 _____.

Step 9

The value of Step 7 divided by Step 8 = _____.

Step 10

The value of Step 4 divided by Step 7 = _____.

Step 11

In Figure 3, the line whose S* value is closest to the value of Step 9 = _____.

Step 12

Locate the value of Step 10 along the horizontal axis of Figure 3. Locate the intersection of that value with the line determined in Step 11. At the corresponding point on the vertical axis, read the Budgetary-Allocation-to-Administrative-Personnel Rating. Record the value in Step 13.

Step 13

Budgetary Allocation Rating = _____.

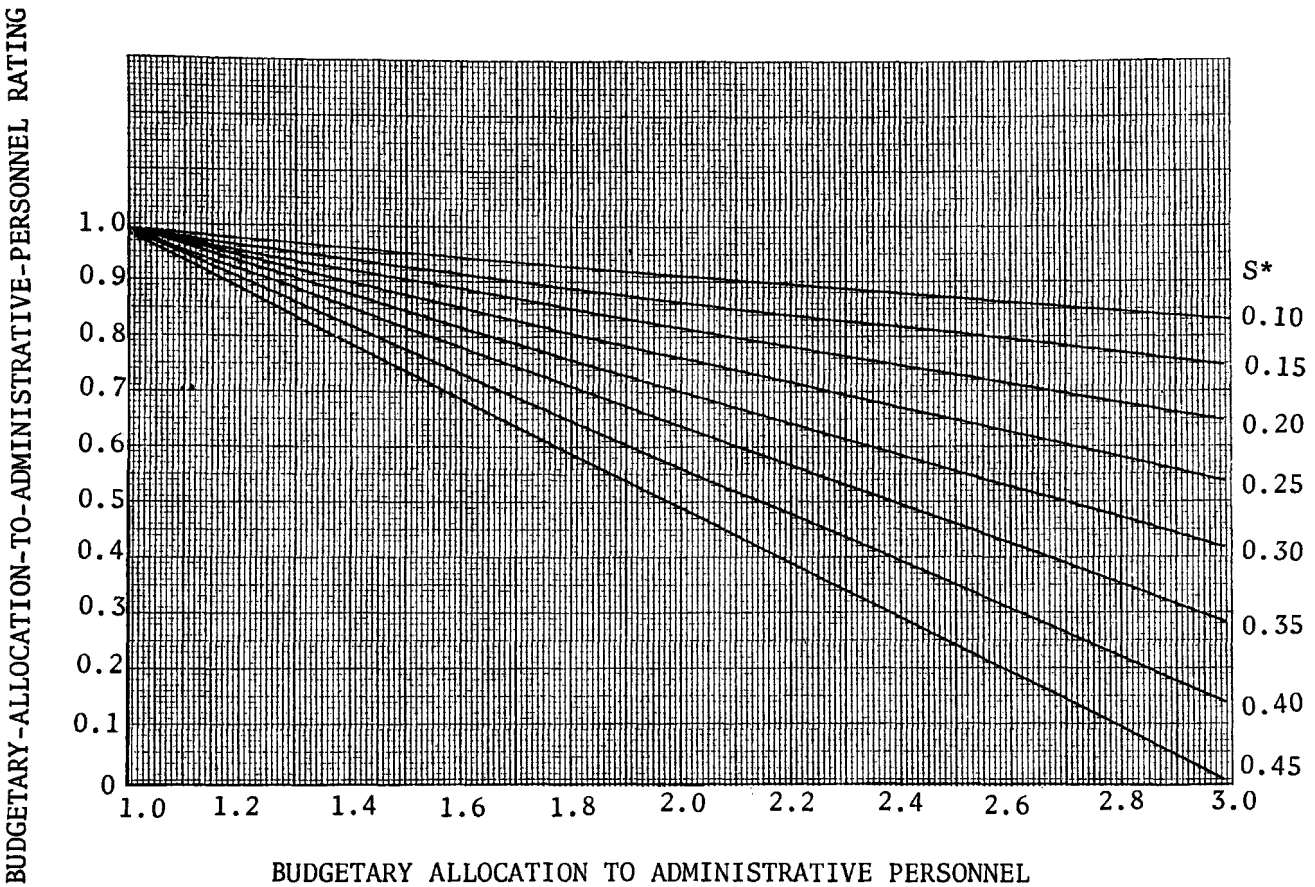
IV.B TECHNICAL SERVICES PERSONNEL QUALIFICATIONS

This Element is divided into the two sub-Elements of Experience and On-Job Formal Training, which are rated separately, using information in Table 3, and Figures 4 and 5. The results are then combined to derive the Elemental Rating, using weighting factors from the Letter Survey.

IV.B.1 Experience Rating and Procedural Steps

Step 1

Sum the years (in Table 3, column 2) that all Technical Services Personnel (i.e., all non-Administrative Personnel) have been in their present positions, divide by the number of such personnel, and list the result _____.



OPTIMAL BUDGETARY ALLOCATIONS TO ADMINISTRATIVE PERSONNEL

Figure 3. Budgetary-allocation-to-administrative-personnel rating

Step 2

On the horizontal axis of Fig. 4, locate the value of Step 1. Locate the intersection of that value with the curve, and read the corresponding value on the vertical axis. Record that value, the Experience rating for Technical Services Personnel = _____.

IV.B.2 Special On-Job Formal Training Rating and Procedural Steps

"Special On-Job Formal Training" consists of training courses, available to personnel who have been employed by the network for a minimum of 1 year. Successful completion of a course allows advancement to a higher salary level more rapidly than by normal promotion. If the network does not offer such training or make it available to personnel, skip the calculations of this Section, and fill in 0 for the Rating in Step 4. If such training is available, proceed with the following Steps to determine the Training Rating.

The column numbers in the Procedural Steps reference the numbered columns of Table 3.

Step 1

List the number of Technical Services Personnel for whom training programs are available (column 7) _____.

Step 2

List the total number of Technical Services Personnel (column 1) _____.

Step 3

Divide the number listed in Step 1 by the number listed in Step 2 and record the value of f, the fraction of Technical Services Personnel for whom training is available; f = _____.

Step 4

Use Figure 5 to determine the rating value for training available to Technical Services Personnel. The result of Section IV.B.1, Step 1, lists the average years of experience in position for Technical Services Personnel. Four curves are shown in Figure 5 for average years experience. Select the curve that most closely matches the result of Section IV.B.1, Step 1. Locate the intersection of the value of f (recorded in Step 3, above), which is plotted on the horizontal axis of Figure 5, with the selected curve. Then determine the corresponding value of Training on the vertical axis. Training rating = _____.

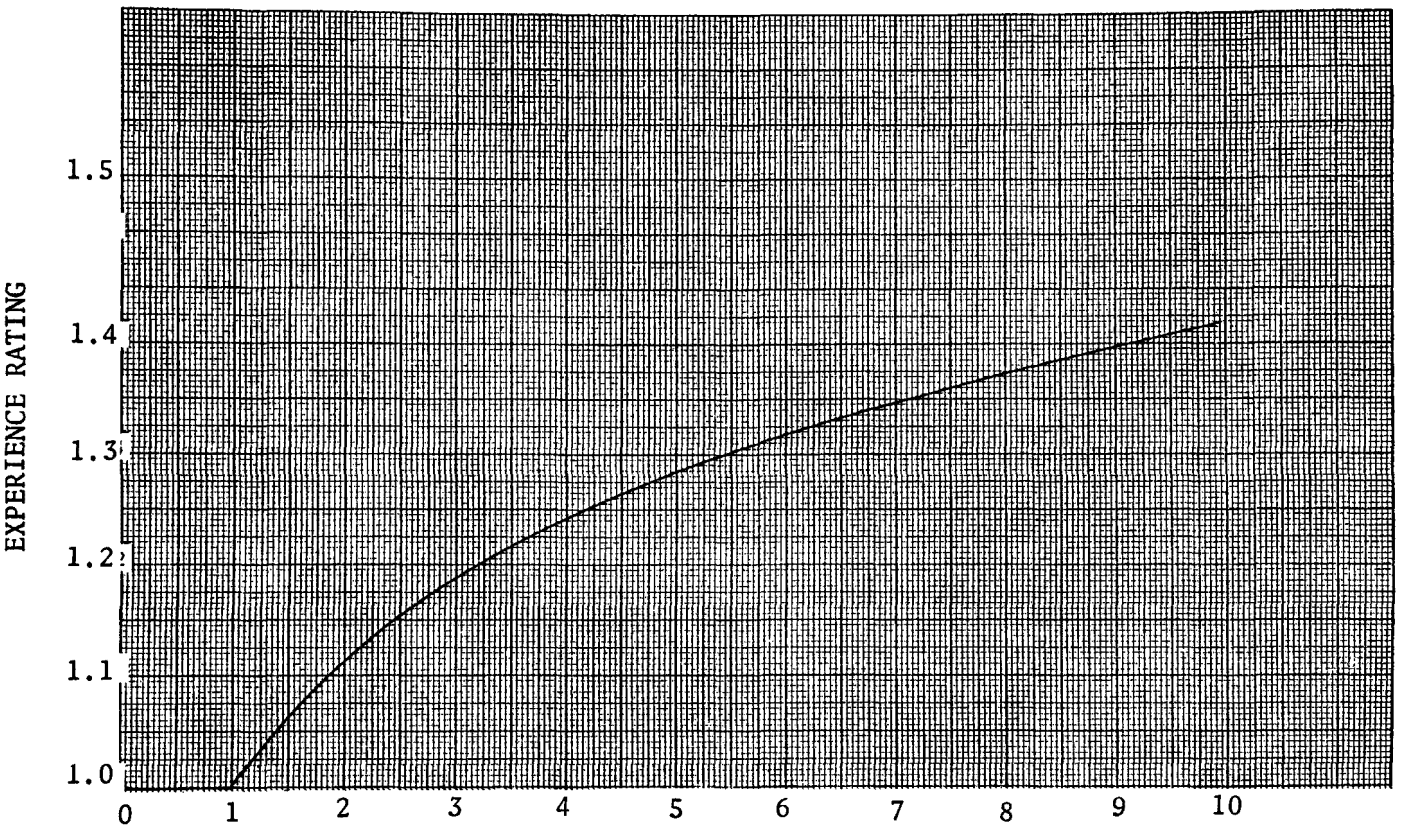


Figure 4. Experience rating curve

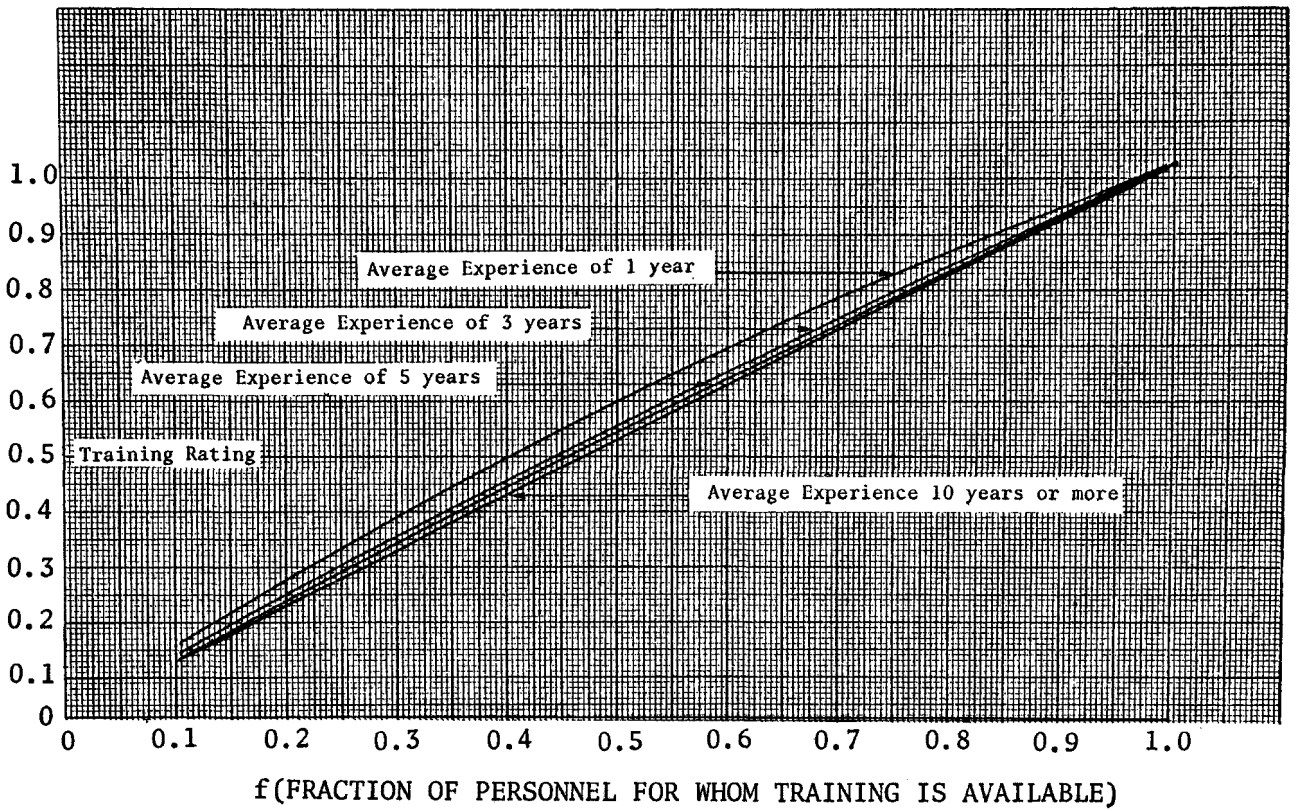


Figure 5. Rating for on-job training program

IV.B.3 Rating of Personnel Qualifications

A Rating of Personnel Qualifications is provided by the sum of the following two weighted ratings:

0.554 x Experience rating of Section B.1, Step 2 = _____.

0.446 x Training rating of Section B.2, Step 4 = _____.

Personnel Qualifications Rating = Sum = _____.

IV.C EVALUATION OF AREA OF PERSONNEL

An Evaluation of the Area of Personnel is provided by the sum of weighted Element Ratings:

0.471 x (Budgetary Allocation Rating of Section IV.A, Step 13) = _____.

0.529 x (Personnel Qualifications Rating of Section IV.B.3) = _____.

Area Evaluation = Sum = _____.

SECTION V

EVALUATION OF THE AREA OF FACILITIES AND EQUIPMENT

All Elements concerning Laboratory equipment and instruments should be rated. If the network does not operate its own laboratory, the ratings should be done with respect to the laboratory that performs the analyses. All Items rated affect efficiency and effectiveness of operations. The information needed has been recorded in Table 4. The rating process is one of recording the value of the Item in Table 10, multiplying that value by the listed weighting factor, and recording the "rating" for each Item. With one exception, the value of each Item is explicit in Table 4, either as a percentage, which is recorded in Table 10 as a decimal number, as a specified numerical value, or as a "Yes," which has a value of 1, or a "No," which has a value of 0. The one value not in Table 4 concerns equipment, which is rated in Element V.B, and will be defined there.

Use Table 10 to record the values and determine the "ratings" for the Items of each Element and the Element Ratings. The Source Reference is given in the first column of Table 10 for each Item, an abbreviated title is given in the second column, the third space is blank for recording the value of the Item, and a weighting factor is given for each Item in the fourth column. Weighting factors are derived from responses to the Letter Survey. The product of the value and the weighting factor is the "rating," to be recorded in the fifth column, for each Item. The Element Rating is recorded in the sixth column, headed R_i. The methodology is explained in detail for the first Element, Office Facilities.

V.A OFFICE FACILITIES

Only two Items are considered significant in affecting the efficiency of the operations in this Element: Space Allocation and Availability of Reference Documents. The method for rating each and for deriving the Element Rating are given in the following Steps.

Procedural Steps

Step 1

In Table 10 (at the end of this Section), record the value for Space Allocation: from the response to item 1.a in Table 4, determine the "value," i.e., if 100% of office personnel have a minimum of 100 sq.ft. (9.29 m^2) per person, the value is 1; if 75% of office personnel have a minimum of 100 sq.ft. per person, the value is 0.75.

Step 2

Multiply the recorded value by the listed weighting factor of .467 and record the result in the "rating" column.

Step 3

Record the value for Availability of Reference Documents. If the response to item 1.b, Table 4 is "Yes," the value is 1; if the response is "No," the value is 0.

Step 4

The "rating" for the Item is then either 1 x 0.533 = 0.533, or 0.

Step 5

Sum the two Item "ratings" to determine the value of R_1 and record the result in the R_i column.

V.B LABORATORY FACILITIES

Note: If the network does not operate its own laboratory, these ratings and those relating to Laboratory Instruments should be carried out, using information on the laboratory that performs the analyses.

The Element of Laboratory Facilities is divided into five sub-Elements, each of which is composed of several Items. Follow the procedure detailed for Element A to determine a "rating" for each Item in sub-Element 1, in Table 10. Sum the five "ratings" and record the result for r_1. Follow the same procedure for sub-Elements 2 and 3. In sub-Element 4, the value of average equipment age is given a value, depending on the response to item 2.d (4) in Table 4. If the

average age is 1 to 3 years, the value is 1;

average age is 3 to 6 years, the value is 0.8;

average age is 6 to 10 years, the value is 0.5.

Follow the methodology as above, and determine and record "ratings" for r_4 and for r_5. The Rating for the Element, R_2, is derived by summing $r_1 + r_2 + r_3 + r_4 + r_5$ and is recorded in the R_i column.

V.C LABORATORY INSTRUMENTS

The "value" of each Item is that recorded for the referenced item in Table 4. Use Table 10 to record the rating for each, and the Element Rating.

V.D LABORATORY INSTRUMENT QUALIFICATIONS

For this Element, if the response to referenced items in Table 4 is "yes," the value of the Item is 1; if the response is "No," the value is 0. Record the value and rating for each item in Table 10, and derive and record the Element Rating.

V.E FIELD FACILITIES

Derive and record the rating for each Item listed, and for the Element. The value of each Item is determined by the answers in the Source References of Table 4. If the percentage of stations with permanent housing is 50% or more, record the value as 1. If the percentage is less than 50%, the value is the actual percent divided by 50%, e.g., if 25% of the stations have permanent housing, the value would be 0.25/0.5 = 0.5. For the other Items, the values are 1 if the answer is yes, or 0 if the answer is no.

V.F FIELD INSTRUMENTS

Derive and record a rating for each Item listed, and for the Element. The values of the first four items are explicit, either 1 or 0. For the fifth item, if 50% or more of the stations have fixed monitors, the value is 1. If less than 50%, the value is the percentage expressed as a decimal, divided by 0.5.

V.G AREA EVALUATION

Record the Rating for each Element, multiply that by the listed weighting factor, and record the product as the Relative Rating (Rel R) of each Element in the Area. The Area Evaluation is the sum of the Relative Ratings. Note that the maximum score would be 1.0, or 100%. Thus, if the Evaluation is 0.94, the major Facilities and Equipment affecting network effectiveness are within 6% of being optimal. In addition, the degree to which each Element is performing with respect to the Area can be gauged by how close the Relative Rating is to the listed weighting factor, and the efficiency of each Element can be gauged by how close the Element Rating is to 1.

TABLE 10. RATINGS FOR FACILITIES

Source ref. table 4 item number	Item	Value x wt. factor = rating	R_i
	A. Office Facilities		
1.a.	Space Allocation	x 0.467 =	
1.b.	Availability of Reference Documents	0.533	
		R_1 = sum =	
	B. Laboratory Facilities		
	1. Space		
2.a.(1)	Individual space allocation	0.040	
2.a.(2)	Bench-top space	0.042	
2.a.(3)	Hood space adequacy	0.041	
2.a.(4)	Drawer space	0.040	
2.a.(5)	Locked area availability	0.042	
		r_1 = sum =	
	2. Cleanliness		
2.b.(1)	Checks on area cleanliness	0.057	
2.b.(2)	Checks on hood cleanliness	0.058	
2.b.(3)	Availability of safety showers	0.031	
2.b.(4)	Debris-free exits	0.030	
		r_2 = sum =	
	3. Environmental Control		
2.c.(1)	Refrig/freezer storage	0.042	
2.c.(2)	Dark dry storage	0.035	
2.c.(3)	Ref. material cold storage	0.031	
2.c.(4)	Separate hood exhausts	0.031	
2.c.(5)	All hoods operable	0.031	
		r_3 = sum =	
	4. Equipment		
2.d.(1)	Permanent set up availability	0.045	
2.d.(2)	Quality of volumetric glassware	0.044	
2.d.(3)	Quality of plastic vessels	0.044	
2.d.(4)	Avg. equipment age	0.036	
2.d.(5)	Fritted ware availability	0.036	
2.d.(6)	Storage of fritted ware	0.026	
		r_4 = sum =	
	5. Availability of Support Facilities		
2.d.(7)(a)	Incubator	0.022	
2.d.(7)(b)	Still	0.030	
2.d.(7)(c)	Ovens	0.022	
2.d.(7)(d)	Water baths	0.022	
2.d.(7)(e)	Recorders	0.026	
2.d.(7)(f)	NBS thermometer	0.023	
2.d.(7)(g)	Compressed air	0.023	
2.d.(7)(h)	Constant voltage source	0.028	
2.d.(7)(i)	Selective ion electrodes	0.022	
		r_5 = sum =	
		$R_2 = r_1+r_2+r_3+r_4+r_5$ =	

TABLE 10. (continued)

Source ref. table 4 item number	Item	Value x wt. factor = rating	R_i
	C. Laboratory Instruments		
	Availability of:		
3.a.(1)	Analytical balances	0.128	
3.a.(2)	Potential (pH meter)	0.102	
3.a.(3)	Conductivity meter	0.100	
3.a.(4)	Turbidimeter	0.086	
3.a.(5)	Visual Spectrophotometer	0.118	
3.a.(6)	U.V. Spectrophotometer	0.076	
3.a.(7)	I.R. Spectrophotometer	0.076	
3.a.(8)	A.A. Spectrophotometer	0.120	
3.a.(9)	Total Carbon Analyzer	0.095	
3.a.(10)	Gas Chromatograph	0.099	
		$\overline{R_3}$ = sum = _____	
	D. Lab. Instrument Qualifications		
	Analytical balances	0.25	
3.b.(1)	pH meters	0.13	
3.b.(2)	Turbidimeter	0.07	
3.b.(3)	Overall sensitivity & precision	0.55	
3.b.(4)		$\overline{R_4}$ = sum = _____	
	E. Field Facilities		
	Permanent housing	0.207	
4.a.(1)	Fully equipped mobile lab.	0.255	
4.a.(2)	Portable equipment vehicle	0.283	
4.a.(3)	Portable refrigerated containers	0.255	
4.a.(4)		$\overline{R_5}$ = sum = _____	
	F. Field Instruments		
	Availability of Portable:		
4.b.(1)	pH meter	0.153	
4.b.(2)	Conductivity meter	0.102	
4.b.(3)	DO meter	0.256	
4.b.(4)	Wet-analytical gear	0.102	
4.c.(1)	Fixed Monitors	0.387	
		$\overline{R_6}$ = sum = _____	

G. Area Evaluation		Values x wt. factor = Rel. R.
Record values of:	R_1	0.109
	R_2	0.184
	R_3	0.189
	R_4	0.190
	R_5	0.149
	R_6	0.179 _____

Area Evaluation = Sum Rel. R. = _____

SECTION VI

EVALUATION OF THE AREA OF SAMPLING

Relative to the Area of Sampling, only two major Elements are considered: (1) Parameters monitored as a function of station location and Region types; and (2) Frequency of monitoring. Analytical procedures are considered in the Area of Quality Assurance. The selected segment will be used as a representative of the network.

VI.A. RATING OF PARAMETERS MONITORED

In the Rating of parameters monitored, the indicator parameters, as functions of Region type and Station-use (defined in the Introduction, Table 1) are used as weighting factors in the rating method. Because tight constraints are placed on effluent discharges, indicator parameters are limited, except upstream and downstream of point source discharges.

Table 11 is provided as a work sheet for rating the parameters monitored in each category, and Table 12 provides the weighting factors for the indicator parameters for the various station categories and two Region types. The procedures are again indicated in Steps, with Source references in either Table 2 or 12, as indicated. The procedure, the same for each Step through 21, is as follows: on the first line for each Step, or category, that is applicable, record in Table 11 the Region type (from Table 1) and the "value" for each parameter, which is the Table 2 value of N, expressed as a decimal number. On the next line of the Step, record as the weight, the weight given in Table 12 for the appropriate indicator parameters, by category and Region types. On the third line of the Step, record the rating, which is the product of the value times the weight for each indicator parameter. Then sum the ratings and record that sum as the category rating in the right-hand column.

In Step 21, sum all the category ratings, and record the value. Step 22 provides the Rating for parameters monitored, the sum of the category ratings divided by the number of categories considered.

VI.B RATING FOR FREQUENCY OF MONITORING

The segment selected in Section II to provide information for the data base will again be used as representative of the primary network operations. Parameters monitored have been divided into five groups, as shown in Table 13. The first Step of this rating procedure consists of recording in Table 13 the average frequency of monitoring each group of parameters for each applicable category. The Source reference items (in Table 2) are listed in the first column of Table 13. Frequency of monitoring, which was coded by letter in Table 2, is interpreted numerically in this rating procedure.

TABLE 11. EVALUATION OF PARAMETERS MONITORED

The rating for each parameter is the product of the value times the weight

	Source ref.	Region type	Parameters											Category rating
			DO	Algal. nut.	Spec. cond.	pH	Alkal/ acid.	Temp.	Metals/ Tox.Mat'l	COD	TOC	Bact. param.	Turbid.	
Step 1	TABLE													
value	2.A.4.a													
weight	12 (1)													
rating														
Step 2														
value	2.A.4.b													
weight	12 (1)													
rating														
Step 3														
value	2.A.5.a													
weight	12 (2)													
rating														
Step 4														
value	2.A.5.b													
weight	12 (2)													
rating														
Step 5														
value	2.A.6.a													
weight	12 (3)													
rating														
Step 6														
value	2.A.6.b													
weight	12 (3)													
rating														
Step 7														
value	2.A.7													
weight	12 (4)													
rating														
Step 8														
value	2.A.8													
weight	12 (4)													
rating														
Step 9														
value	2.A.9													
weight	12 (4)													
rating														
Step 10														
value	2.A.10.a.													
weight	12 (5)													
rating														
Step 11														
value	2.A.10.b													
weight	12 (5)													
rating														
Step 12														
value	2.A.11													
weight	12 (10)													
rating														
Step 13														
value	2.A.12													
weight	12													
rating														
Step 14														
value	2.A.13.a													
weight	12 (6)													
rating														
Step 15														
value	2.A.13.b													
weight	12 (6)													
rating														
Step 16														
value	2.A.14.a													
weight	12 (7)													
rating														
Step 17														
value	2.A.14.b													
weight	12 (7)													
rating														
Step 18														
value	2.A.15													
weight	12 (8)													
rating														
Step 19														
value	2.A.16													
weight	12 (8)													
rating														
Step 20														
value	2.A.17													
weight	12													
rating														
Step 21													Sum of category ratings	

Step 22 R_1 = Rating Value of Step 21 divided by number of Categories

TABLE 12. WEIGHTING FACTORS FOR INDICATOR PARAMETERS BY CATEGORY

1. Receiving Waters Up- or Downstream of Significant Point Source Discharges

Parameter	Weighting factor
Trace metals	0.111
Toxic materials	0.111
Algal nutrients	0.102
Bacteriological parameters	0.094
Biota/species diversity	0.084
Temperature	0.094
DO	0.099
Specific conductance	0.082
Turbidity	0.057
pH	0.084
Alkalinity/acidity	0.084

Region of "Normal" Rainfall	Arid Region

2. Up- and Downstream of Municipal and Industrial Centers

Parameter	Weighting factor
Bacteriological parameters	0.237
DO	0.218
Biota/species diversity	0.202
pH	0.175
Turbidity/suspended solids	0.168

Parameter	Weighting factor
Bacteriological parameters	0.157
DO	0.144
Biota/species diversity	0.133
pH	0.115
Turbidity/suspended solids	0.111
Alkalinity	0.155
Specific conductance	0.078
Algal nutrients	0.148

3. Up and Downstream of Urban/Suburban Areas

Parameter	Weighting factor
DO	0.291
Bacteriological parameters	0.282
Algal nutrients	0.255
Turbidity	0.171

Parameter	Weighting factor
DO	0.162
Bacteriological parameters	0.157
Algal nutrients	0.142
Turbidity	0.095
Alkalinity	0.154
Specific conductance	0.136
pH	0.154

TABLE 12. (continued)

4. Drinking Water Uptakes, Reservoirs, Recreational Water Bodies

Parameters	Weighting factor
Bacteriological Parameters	0.141
Toxic Materials	0.120
Trace Metals	0.120
DO	0.109
Algal Nutrients	0.091
Turbidity/Suspended Solids	0.091
Biota/Species Diversity	0.090
Temperature	0.085
pH	0.082
Specific conductance	0.070

Parameters	Weighting factor
Bacteriological Parameters	0.131
Toxic Materials	0.111
Trace Metals	0.111
DO	0.100
Algal Nutrients	0.084
Turbidity/Suspended Solids	0.084
Biota/Species Diversity	0.084
Temperature	0.078
pH	0.076
Specific conductance	0.064
Alkalinity	0.076

5. Watershed/Wilderness area

a. Upstream

Parameters	Weighting factor
DO	0.162
Biota/Species Diversity	0.155
Temperature	0.154
Turbidity/Suspended Solids	0.154
Algal Nutrients	0.145
Specific conductance	0.102
pH	0.068
Trace Metals	0.060

Parameters	Weighting factor
DO	0.154
Biota/Species Diversity	0.147
Temperature	0.146
Turbidity/Suspended Solids	0.146
Algal Nutrients	0.137
Specific conductance	0.097
pH	0.065
Trace Metals	0.057
Alkalinity	0.053

b. Downstream

Parameters	Weighting factor
DO	0.311
Temperature	0.295
Algal Nutrients	0.278
Trace Metals	0.115

Parameters	Weighting factor
DO	0.213
Temperature	0.203
Algal Nutrients	0.191
Trace Metals	0.079
Alkalinity	0.090
pH	0.090
Specific conductance	0.134

Region of Average Rainfall

Arid Region

6. Upstream and Downstream of Irrigated Farmland

Parameter	Weighting factor
DO	0.357
Bacteriological parameters	0.286
Turbidity/suspended solids	0.214
Algal nutrients	0.143

Parameter	Weighting factor
DO	0.217
Bacteriological parameters	0.174
Turbidity/suspended solids	0.130
Algal nutrients	0.087
Alkalinity	0.130
Specific conductance	0.130
pH	0.130

TABLE 12. (continued)

7. Mining or Geothermal Regions

Parameter	Weighting factor
Trace metals	0.20
Toxic materials	0.20
Specific conductance	0.20
pH	0.15
Alkalinity/acidity	0.15
Turbidity/suspended solids	0.10

Parameter	Weighting factor
Trace metals	0.20
Toxic materials	0.20
Specific conductance	0.20
pH	0.15
Alkalinity/acidity	0.15
Turbidity/suspended solids	0.10

8. Boundary Stations, Up and Downstream

Parameter	Weighting factor
DO	0.168
Biota/species diversity	0.160
Temperature	0.159
Turbidity	0.159
Algal nutrients	0.107
Specific conductance	0.106
Alkalinity/acidity	0.071
pH	0.071

Parameter	Weighting factor
DO	0.168
Biota/species diversity	0.160
Temperature	0.159
Turbidity	0.159
Algal nutrients	0.107
Specific conductance	0.106
Alkalinity/acidity	0.071
pH	0.071

9. Parameters measured at mouths of tributaries to mainstem rivers or at representative locations will depend on activities being monitored, and therefore will fall into one of the categories above.

10. Eutrophic or Potentially Eutrophic Water Bodies

Parameter	Weighting factor
Algal nutrients	0.333
DO	0.333
Turbidity	0.167
Temperature	0.167

NONE

TABLE 13. FREQUENCY OF MONITORING

Record for each of the categories applicable to the segment, the average frequency of monitoring the five groups of parameters shown. Express the average frequency numerically, as follows:

C = Continuous = 30
D = Daily = 20
W = Weekly = 4
M = Monthly = 1.0

bM = bimonthly = 0.5
Q = Quarterly = 0.33
T = Three times/year = 0.25
SY = Semiannually = 0.167
Y = Annually = 0.083

Station category Table 2. Source item	Trace metals Toxic materials (avg. freq.)	Plankton (avg. freq.)	Other biota (avg. freq.)	All other water quality parameters (avg. freq.)	Hydrological parameters (avg. freq.)
Step 1 4a 4b 5a 5b 6a 6b 7 8 9 10a 10b 11 12 13a 13b 14a 14b 15 16 17					
Step 2 Total					
Step 3 No. categories					
Step 4 Overall average (Step 2/Step 3)					
Step 5 Rating					

Step 6 Sum of 5 ratings _____

Step 7 R_2 = Rating for element = $\frac{\text{Sum of ratings}}{5}$ = _____

Numerical values for each frequency code are given at the top of Table 13. The values are based on recommended minimum monitoring frequencies listed in the U.S. EPA, June 1975.

After recording the average monitoring frequency for each group of parameters in each applicable category, if the average frequency in each category within the group is the same, record that value as the Overall average in Step 4. If the frequency varies within the group, carry out the calculations of Steps 2, 3, and 4, to determine the Overall average.

Locate the Overall average frequency of monitoring for each group of parameters on the horizontal axis of Figures 6, 7, or 8 (the figure title indicates the group with which it is used). Determine the rating for each group, i.e., the point on the vertical axis that corresponds to the intersection of the Overall average value with the plot. Record those values in Step 5.

Steps 6 and 7 provide the Rating for the Element. The value of 1 is the optimal Rating.

VI.C EVALUATION OF AREA OF SAMPLING

An Evaluation for the parameters monitored and the frequency of monitoring is obtained by multiplying each Rating times a weighting factor, and summing the two results. The weighting factors are derived from the Letter Survey.

Source	Rating x Weighting Factor	=	Relative Evaluation
Table 11 (R_1)	0.54	=	
Table 13 (R_2)	0.46	=	_____
	Evaluation = Sum =		_____

The optimal evaluation is 1.

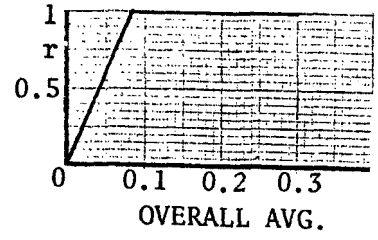


Figure 6. Rating for monitoring frequency of trace metals/toxic materials and biota

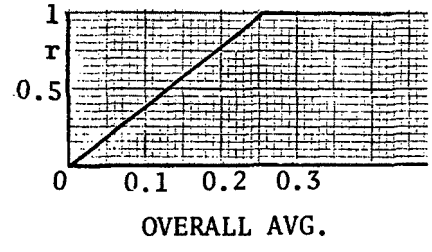


Figure 7. Rating for monitoring frequency of plankton

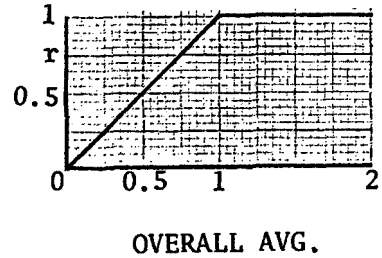


Figure 8. Rating for monitoring frequency of other water quality and hydrological parameters

SECTION VII

EVALUATION OF THE AREA OF QUALITY ASSURANCE

Six Elements are rated in this Section. The rating procedure is similar to that in previous Sections. The value of each item is determined from the Source Reference item in Table 4, listed in the first column of Table 14. As in previous cases, the Source Reference items provide values of 1, 0, or the decimal equivalent of a percentage, with a few exceptions in Elements E and F, which are defined below. Record R, the rating for each Element, in the column headed R_i. Element E contains eight sub-Elements, ratings for which are recorded in the column headed "rate," and they are summed and weighted at the end of the Element, as indicated in the Table.

Table 14 is located at the end of this Section.

VII.A FIELD INSTRUMENT CALIBRATION

Record in Table 14 the value and rate for each item, and the Element Rating, R_1.

VII.B FIELD INSTRUMENT MAINTENANCE

Record in Table 14 the value and rate for each item, and the Element Rating, R_2.

VII.C FIELD MEASUREMENT CONTROLS

Record in Table 14 the value and rate for each item, and the Element Rating, R_3.

VII.D LABORATORY INSTRUMENT CALIBRATION

Record in Table 14 the value and rate for each item, and the Element Rating, R_4.

VII.E LABORATORY MEASUREMENT CONTROLS

This Element is composed of eight sub-Elements, each of which has several components. Calculations are the same as those for the previous Elements; however, each sub-Element rating is the sum of the ratings of its components. The method for rating the Element is given in Table 14. Values for components of sub-Elements 1 through 4 are explicit in Table 4. The derivation follows for those values that are not explicit for the remaining sub-Elements.

Sub-Element 5, Validation Techniques Values are determined as follows:

(1) if replicate analyses are performed at least for every set of samples (or approximately 20 samples), the value is 1; if less frequently, the value is 0.

(2) The value is 1 if all three responses are "yes"; value is 0.67 if two responses are "yes"; value is 0.33 if one response is "yes"; value is 0 if there are no "yes" responses.

(3) The value is 1 if spiked samples are run for approximately every 20 samples; the value is 0 if run less frequently.

(4) The value is 1 for a "yes", 0 for a "no".

Sub-Element 6, Documented Check lists. The values are 1 for "yes", 0 for "no".

Sub-Element 7, Records. The value for item Source Reference 6.(f) is 1 if permanent records are in bound notebooks, 0 if on unbound sheets.

Sub-Element 8, Quality Assurance Program. The value is 1 if the percentage of committed resources is 15% or more. If the percentage is less than 15%, the value is the decimal equivalent of the percentage divided by 0.15.

The Element Rating R_5, is the sum of the products of each sub-Element rate and a weighting factor, as indicated in Table 14.

VII.F FACTORS AFFECTING LABORATORY SUPPLIES

Record the value and rate for each item and the Element Rating, R_6.

VII.G AREA EVALUATION

An evaluation is derived for the Area of Quality Assurance by summing the products of each Rating and its weighting factor. The weights are given in Table 14. A final evaluation of 1 is the optimal value.

TABLE 14. RATING FOR QUALITY ASSURANCE

Source ref. Table 4.		Item	Value x Weight factor = Rate	R_i
4.d.	A.	Field Instrument Calibration		
(1)		Field meters	0.273	
(2)		Fixed sensors	0.272	
(3)		Calibration frequency	0.245	
(4)		Use of documentation	0.210	
			R_1 = Sum =	
4.e.	B.	Field Instrument Maintenance		
(1)		Documentation of schedule	0.354	
(2)		Use of documentation	0.326	
(3)		Calibration frequency	0.319	
			R_2 = Sum =	
4.f.	C.	Field Measurement Controls		
(1)		Downtime documentation/eval.	0.171	
(2)		Validation of transmitted data	0.232	
(3)		Validation of secondary standards	0.218	
(4)		Scheduled preventative maint.	0.222	
(5)		Stat. control chart techniques	0.157	
			R_3 = Sum =	
3.c.	D.	Lab. Instrument Calibration		
(1)		Documented schedules	0.357	
(2)		Frequency as mfr. recommends	0.321	
(3)		Use of documentation	0.322	
			R_4 = Sum =	
	E.	Laboratory Measurement Controls		
3.c.		1. Analytical method calibrations		
(4)		Balances serviced	0.154	
(5)		Availability of Class S weights	0.210	
(6)		Documentation of weight checks	0.090	
(7)		Spectrophotometer. wave-length verification	0.210	
(8)		Documentation of (7)	0.126	
(9)		Primary std.Ck.of vol.anal.	0.210	
			r_1=Sum =	

TABLE 14. (continued)

Source ref. Table 4	Item	Value x Weight factor = Rate	R_i
5.a.	E. Laboratory Measurement Controls		
	2. Containers, preservation, holding		
(1)	Glass containers	0.174	
(2)	Ref.2 preservation techniques	0.194	
(3)	Other preservation techniques	0.155	
(4)	Ref. 2 holding times	0.148	
(5)	Other holding times	0.135	
(6)	Sample volumes	0.194	_____
		r_2=Sum =	_____
5.b.	3. Analytical methods		
(1)	Procedures used	0.300	
(2)	Procedure write up	0.210	
(3)	Compliance tests	0.250	
(4)	Use of stat. control	0.240	_____
		r_3=Sum =	_____
5.c.	4. Cleaning methods		
(1)	Standard methods	0.384	
(2)	Special cleaning	0.325	
(3)	Filter cleaning	0.291	_____
		r_4=Sum =	_____
5.d.	5. Validation techniques		
(1)	Replicate analyses	0.253	
(2)	Sample tests	0.283	
(3)	Spike samples	0.242	
(4)	Interlab. comparison	0.22	_____
		r_5=Sum =	_____
6.a	6. Documented check lists		
(1)	Compressed air purity	0.144	
(2)	Distilled water purity	0.252	
(3)	Deionized water purity	0.244	
(4)	Vacuum system purity	0.117	
(5)	Reagents and solvents stds.	0.243	_____
		r_6=Sum =	_____

TABLE 14. (continued)

Source ref. Table 4	Item	Value x	Weight factor =	Rate R_i
6.	7. Records			
(b)	Bench record corrections		0.117	
(c)	Signed records		0.174	
(d)	Chain-of-custody		0.148	
(e)	Permanent records		0.142	
(f)	Record form		0.111	
(g)	Numbered samples		0.123	
(h)	Samples logged		0.185	_____
			r_7=Sum =	_____
7.	8. Quality Assurance Program			
(a)	Written program		0.328	
(b)	Appointed officer		0.371	
(c)	Committed resources		0.301	_____
			r_8=Sum =	_____

$$R_5 = (.158)r_1 + (.115)r_2 + (.120)r_3 + (.94)r_4 + (.149)r_5 + (.075)r_6 + (.175)r_7 + (.114)r_8$$ R_5 = _____

2.e.	F. Factors Affecting Supplies			
(1)	Storage		0.150	
(2)	Handling		0.150	
(3)	Std. reference materials		0.195	
(4)	Inventory		0.183	
(5)	Purchasing guidelines		0.104	
(6)	Chemicals dated		0.218	_____
				R_6=Sum = _____
	G. Area Evaluation			
		R_1 =	0.191	
		R_2 =	0.152	
		R_3 =	0.173	
		R_4 =	0.188	
		R_5 =	0.180	
		R_6 =	0.120	_____
	Area Evaluation =	Sum	=	_____

SECTION VIII

EVALUATION OF THE AREA OF DATA DISTRIBUTION AND DISSEMINATION

Six Items are rated in this Area as listed in Table 15, along with the Source References and the weighting factors. The sum of the Ratings provides the Area Evaluation.

Values of the Items in Table 15 are as follows:

(1) The value is 1 if data are available immediately after processing. If data are released only on a periodic basis, the value is 0.

(2) For all other Items listed, the value is 1 if the response is "yes", 0 if "no".

Calculate the Rating for each, and the Area Evaluation, as indicated in the Table.

TABLE 15. EVALUATION OF DATA DISTRIBUTION AND UTILIZATION

Source Table 5	Item	Value x Weight = R
1.	Data turnaround time	x 0.190 =
2.	Data supplied to STORET	0.143
3.	Data release to public	0.143
4.	Data used to develop models	0.143
5.	Enforcement support	0.238
6.	Data flow to next higher agency	0.143
		Area Evaluation = Sum = _____

SECTION IX

EVALUATION OF THE AREA OF AGENCY INTERACTION

In this Section, the amount of interaction with other agencies is measured by the number of effectively contributing stations operated by other agencies. The selected segment will again be used as representative of the network.

AMOUNT OF INTERACTION

For this Evaluation, all information is in Table 2, items 2 and 3.

Procedural Steps

Step 1

Record the total number of stations in the segment (item 2). _____

Step 2

Record the total number of effectively contributing stations operated by other agencies (item 3). _____

Step 3

Divide the number in Step 2 by the number in Step 1, and record the decimal value. _____

Step 4

Record the total number of agencies operating effectively contributing stations. _____

Step 5

Determination of Rating for effectively Contributing Stations: If the value of Step 3 is 0.25 or greater, the value for Rating is 1; if it is less than 0.25, divide the actual value by 0.25 to determine the Rating. Record the result as the Rating for the Percentage of Stations Contributing Effectively = R_1 = _____.

Step 6

Determination of Rating for Contributing Agencies:
If the value of Step 4 is 3 or more, the value of the Rating

R_2 is 1; if the number is less than 3, divide the actual number by 3, to determine the value of R_2. Record the result as the Rating for Contributing Agencies = R_2 = _____.

Step 7

To Evaluate the Area, sum the values of R_1 and R_2, and divide by 2.

$$\text{Evaluation of Area of Agency Interaction} = \frac{R_1 + R_2}{2}$$

$$= \_\_\_\_\_$$

SECTION X

OVERALL EVALUATION OF NETWORK OPERATIONS

A final evaluation of network operations is derived by integrating the individual Area Evaluations. The integration is accomplished by multiplying each Area Evaluation by a weighting factor derived from the Letter Survey. Each weighting factor used is derived from the normalized mean responses for the relative weights of each Area, with respect to meeting the purpose of documenting progress toward the attainment, or the maintenance, of both ambient and discharge water quality objectives.

Record in Table 16 as the "value" the Evaluation derived in each Section, and multiply each by the indicated weighting factor. Record each product in the column headed "Relative Evaluation." Sum the Relative Evaluations to derive the Overall Evaluation. The optimal value is 1.

TABLE 16. OVERALL EVALUATION OF NETWORK OPERATIONS

Source	Item	Value	x	Weight factor	=	Relative evaluation
Section III.C.	Network Plan and Design		x	0.167	=	
Section IV.C.	Personnel			0.152		
Table 10	Facilities and Equipment			0.141		
Section VI.C.	Sampling			0.150		
Table 14	Quality Assurance			0.157		
Table 15	Data Distribution and Utilization			0.115		
Section IX, Step 7	Agency Interactions			0.118		_____
	Sum = Overall Evaluation of Network Operations				=	_____

SECTION XI

EVALUATION OF BUDGET ALLOCATION TO TECHNICAL SERVICES

In this Section, a Rating is derived for the budgetary allocation to the Technical Services portion of the network. It is considered that Technical Services is comprised of two groups: A, Water Quality Monitoring and Laboratory and Data Analysis; and B, Compliance. The budgetary allocation to the personnel in each group is rated separately. The two Personnel Ratings are then used to derive a Rating for the allocation to Technical Services.

XI.A BASIC DATA

Record the basic data for determining Budget Allocation Ratings in Table 17.

TABLE 17. BASIC BUDGET DATA

Item	Value
1. Total Technical Services Personnel Budget (line 4 of Table 6, Monitoring and Analysis and Compliance)	
2. Total Network Budget (line 1 of Table 6)	
3. Value of Item 1 divided by value of Item 2, Network Budget Fractional Allocation to Technical Services Personnel	
4. Total Budget Allocation to Technical Services (line 2 of Table 6)	
5. Value of Item 1 divided by value of Item 4, Technical Services Budget Fractional Allocation to Personnel	

XI.B RATING FOR BUDGET ALLOCATION TO SURFACE WATER QUALITY MONITORING, LABORATORY AND DATA ANALYSIS PERSONNEL

The Rating is derived in the following Steps:

Procedural Steps

Step 1

In Figure 9, locate the intersection of the value of item 3 of Table 17 along the horizontal axis, and the value of item 5, Table 17 along the vertical axis. If the intersection point lies in the shaded region, follow the procedures of Step 1.a.; if the point lies below the shaded region, follow the procedure of Step 1.b.; if the point lies above the shaded region, follow the procedures of Step 1.c.

a. If the point lies in the shaded region, enter the value 1.0 in Step 2.

b. Determine the vertical axis value of a point on curve A immediately above the calculated point. In the lower half of Figure 10 find the r_1^* curve closest to this vertical axis value. On this r_1^* curve, locate the value determined in item 5 of Table 17, along the horizontal axis. Then read the Budget Allocation Rating for this point on the vertical axis. Record this Budget Allocation Rating in Step 2.

c. Determine the vertical axis value of a point on curve B immediately below the calculated point. In the upper half of Figure 10 find the r_1^* curve closest to this vertical axis value. On this r_1^* curve, locate the value determined in item 5 of Table 17, along the horizontal axis. Then read the Budget Allocation Rating for this point on the vertical axis, and record the value as the Budget Allocation Rating in Step 2.

Step 2

The Rating of the Budgetary Allocation to Surface Water Quality Monitoring and Laboratory and Data Analysis Personnel = _____.

XI.C RATING FOR BUDGETARY ALLOCATION TO COMPLIANCE PERSONNEL

Procedural Steps

Step 1

Follow the instructions of XI.B, Step 1, but use Figure 11 instead of Figure 10. Enter the result in Step 2, below.

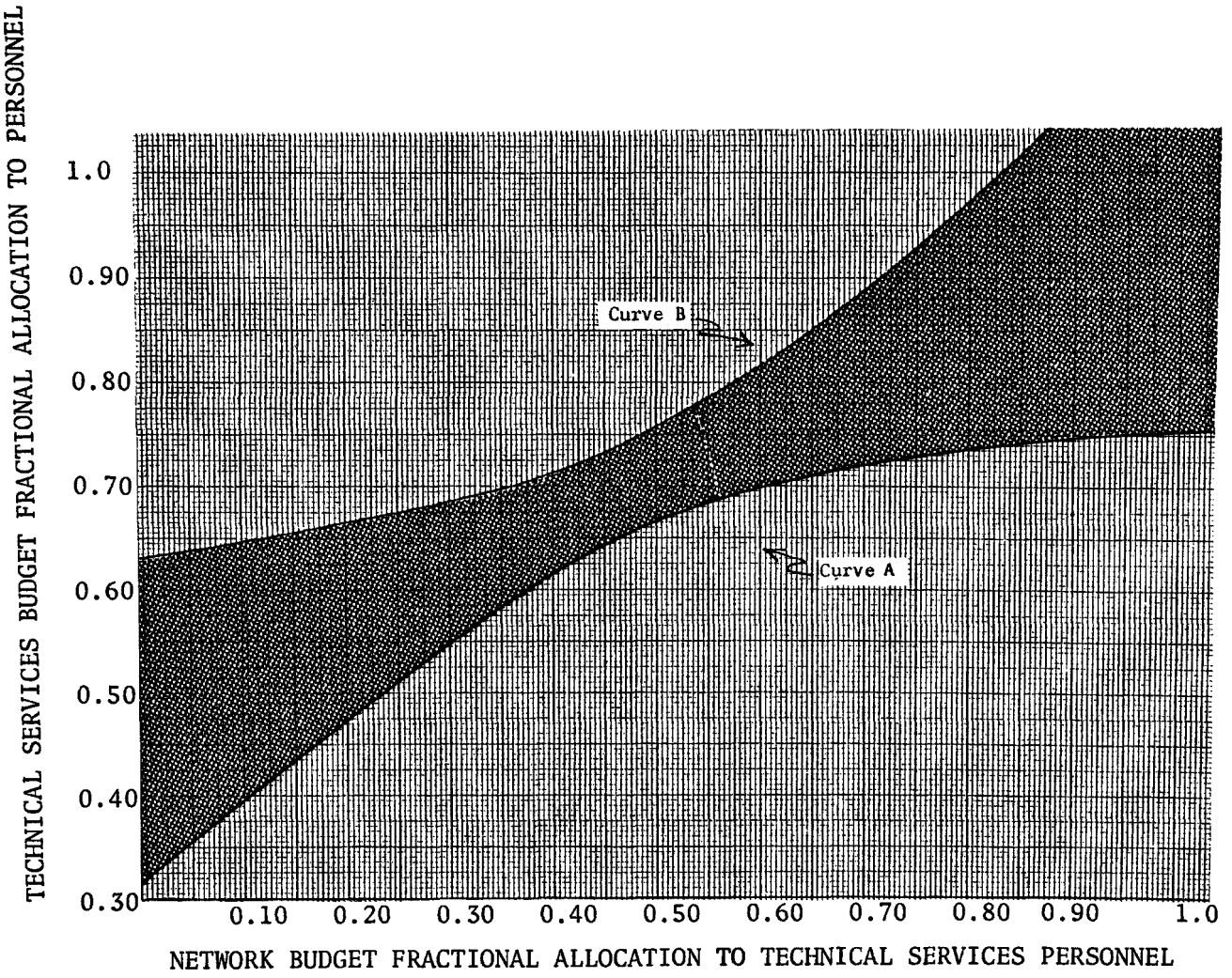


Figure 9. Determination of technical services personnel budget allocation

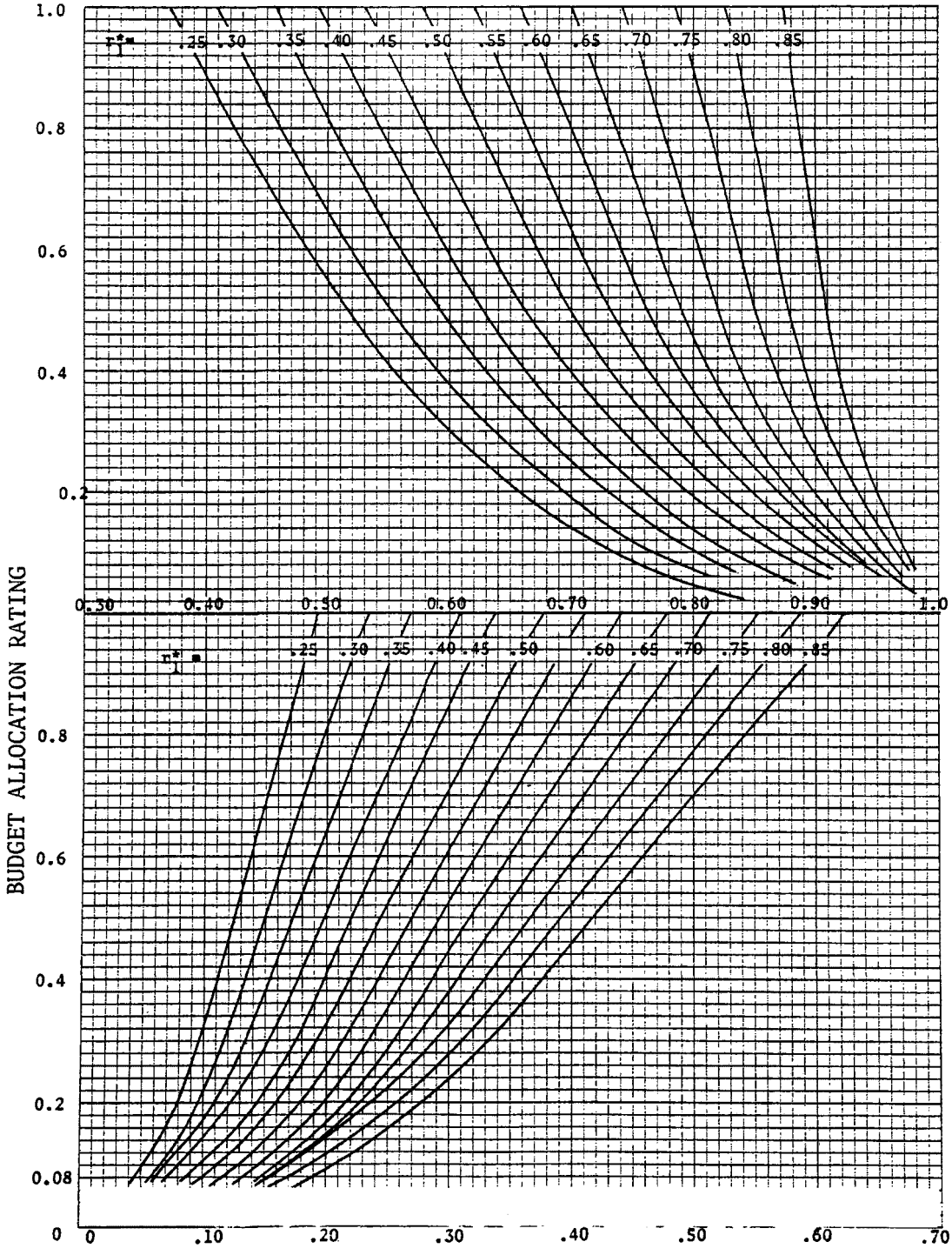


Figure 10. Surface water monitoring, laboratory, and data analysis

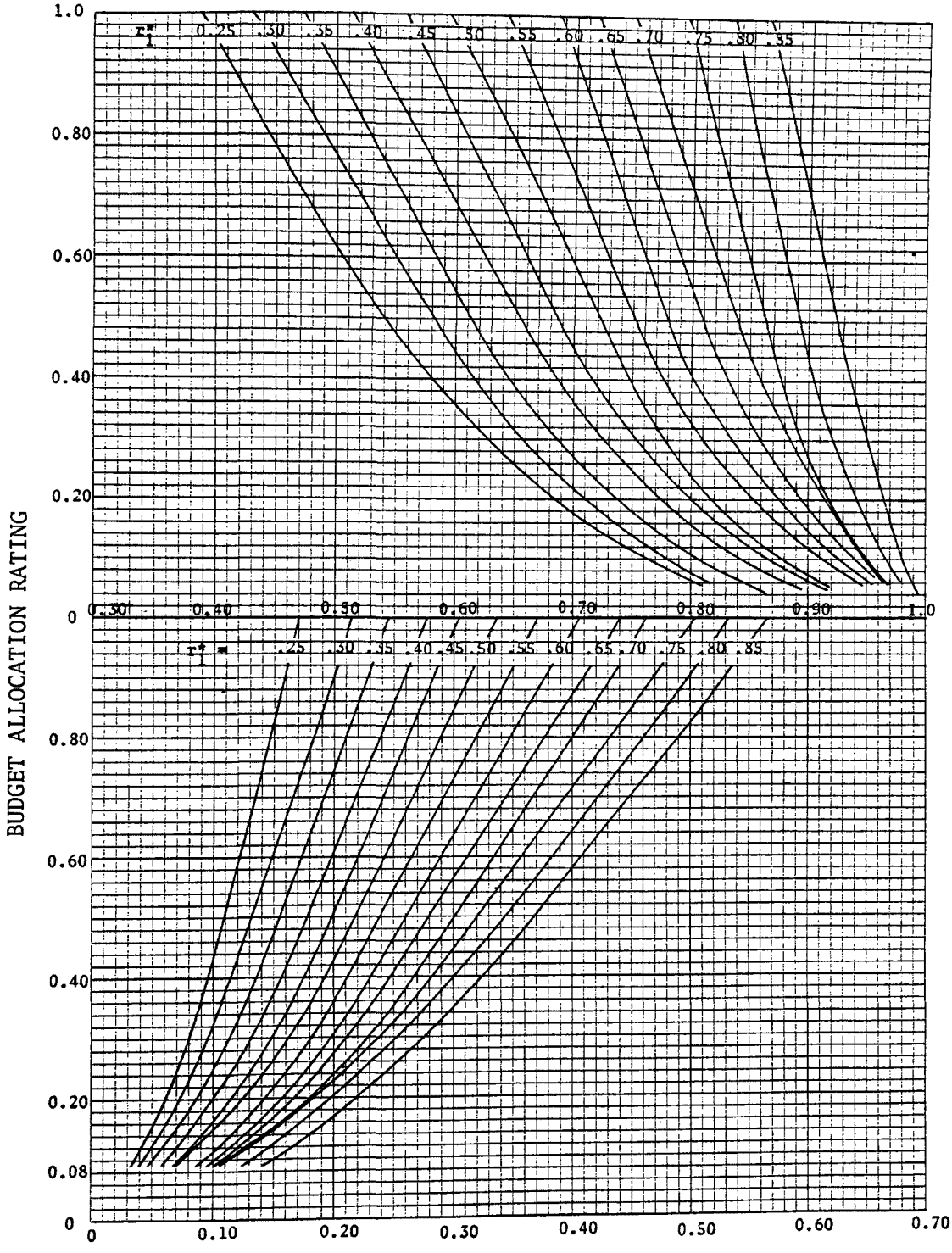


Figure 11. Compliance personnel budget allocation rating

Step 2

The Rating of the Budgetary Allocation to Compliance personnel = _____.

XI.D EVALUATION OF TECHNICAL SERVICES BUDGET ALLOCATION

Procedural Steps

Step 1

Determine the fraction of the total Technical Services budget (line 2 in Table 6) that is allocated to compliance monitoring. _____

Step 2

Compute 1 minus value recorded in Step 1 above. _____

Step 3

The product of the value recorded in XI.D., Step 1 times the value of the Rating of the Budget Allocation to Compliance Personnel (XI.C, Step 2) = _____.

Step 4

The product of the value recorded in XI.D., Step 2 times the value of the Rating of the Budget Allocation to Surface Water Quality Monitoring and Laboratory and Data Analysis Personnel (XI.B., Step 1) = _____.

Step 5

The sum of the values of Steps 3 and 4 is the Evaluation of the Technical Services Budget Allocation = _____.

SECTION XII

REFERENCES

American Public Health Association, Standard Methods for the Examination of Water and Wastewater, 1975.

Code of Federal Regulations:

Title 40, Part 124, "State Program Elements Necessary for Participation in the National Pollutant Discharge Elimination System," Dec. 22, 1972, amended July 24, 1973, later amended March 18, 1976.

Title 40, Part 125, "National Pollutant Discharge Elimination System," May 22, 1973, amended July 16, 1975, later amended March 18, 1976.

Title 40, Part 130, "Policies and Procedures for State Continuing Planning Process," June 3, 1974, amended Nov. 28, 1975 without the term "State" in Title.

Title 40, Part 131, "Preparation of State Water Quality Management Plans," June 3, 1974, amended Nov. 28, 1975.

Title 40, Part 136, "Test Procedures for the Analysis of Pollutants," October 16, 1973.

Federal Register:

"Water Quality and Pollutant Source Monitoring," Vol. 39, No. 168, Appendix A #17, Aug. 28, 1974.

U.S. Congress, Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, 92nd Congress, Oct. 18, 1972.

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Biological Field and Laboratory Methods, Office of Research and Development, National Environmental Research Center, Cincinnati, Ohio, EPA-670/4-73-001, July 1973.

Guidelines for Review of Chemistry Forms, Robert L. Booth, Technical Coordinator, Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, Cincinnati, Ohio, April 1975.

Handbook for Analytical Quality Control in Water and Wastewater Laboratories, by Analytical Quality Control Laboratory, National Environmental Research Center, Cincinnati, Ohio, June 1972.

Methods for Chemical Analysis of Water and Wastes, Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, Cincinnati, Ohio, EPA-625/6-74-003, 1974.

Model State Water Monitoring Program, prepared by National Water Monitoring Panel, edited by Water Monitoring Task Force, R.L. Crim, Chairman, Office of Water and Hazardous Materials Monitoring and Data Support Division, EPA-440/9-74-002, June 1975.

SECTION XIII

GLOSSARY OF TERMS

The source of each definition is either the Code of Federal Regulations, Public Law 92-500, or as indicated.

"Administrator" means the Administrator of the U.S. Environmental Protection Agency.

(40 CFR 124.1 (d)), 1973

"Basin" means the streams, rivers, tributaries, and lakes and the total land and surface water area contained within one of the major or minor basins defined by EPA, or any other basin unit as agreed upon by the State(s) and the Regional Administrator. Unless otherwise specified, "basin" shall refer only to those portions within the borders of a single State.

(40 CFR 130.2 (1)), 1974

"Basin Plan" means the water quality management plan for each hydrologic basin or other approved basin unit within a State. Such plans form a basis for implementing applicable effluent limitations and water quality standards, and consist of such elements as are necessary for sound planning and program management in the basin covered by the plan. Requirements for the preparation of basin plans are described in Part 131 of this chapter.

(40 CFR 130.2 (f)), 1974

"Biological Monitoring" shall mean the determination of the effects on aquatic life, including accumulation of pollutants in tissue, in receiving waters due to the discharge of pollutants.

(PL 92-500, Sec. 502 (15))

"Director" means the chief administrative officer of a State water pollution control agency or interstate agency. In the event responsibility for water pollution control and enforcement is divided among two or more State or interstate agencies, the term "Director" means the administrative officer authorized to perform the particular procedure to which reference is made.

(40 CFR 124.1 (f)), 1973

"Discharge" when used without qualification includes a discharge of a pollutant, and a discharge of pollutants.

(PL 92-500, Sec. 502 (16))

"Minor Discharge" means any discharge which (1) has a total volume of less than 50,000 gallons on every day of the year, (2) does not affect the waters of more than one State, and (3) is not identified by the State water pollution control agency, the Regional Administrator, or by the Administrator in regulations issued pursuant to section 307(a) of the Act, as a discharge which is not a minor discharge. If there is more than one discharge from a facility and the sum of the volumes of all discharges from the facility exceeds 50,000 gallons on any day of the year, then no discharge from the facility is a minor discharge as defined herein.

(40 CFR 125.1 (m)), 1975

"Point Source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.

(PL 92-500, Sec. 502 (14))

The term "Regional Administrator" means one of the EPA Regional Administrators.

(40 CFR 124.1 (e)), 1973

"Representative Point" means a location in surface waters, ground waters, sewer systems, or discharger facilities at which specific conditions or parameters may be measured in such a manner as to characterize or approximate the same at some other location, or throughout a reach, segment, or body of water.

EPA 440/9-74-002, p. III-4

"Segment" means a portion of a basin, the surface waters of which have common hydrologic characteristics (or flow regulation patterns); common natural physical, chemical, and biological processes; and common reactions to external stresses, such as the discharge of pollutants.

(40 CFR 130.2 (m)), 1974

"Significant Discharge" means any point source discharge for which timely management action must be taken in order to meet the water objectives for the basin within the period of the operative basin plan. The significant nature of the discharge is to be determined by the State, but must include, at a

minimum, any discharge which is causing or will cause serious or critical water quality problems relative to the segment to which it discharges.

(40 CFR 130.2 (n)), 1974

"Toxic Pollutant" means those pollutants, or combinations of pollutants, including disease-causing agents, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will, on the basis of information available to the Administrator, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

(PL 92-500, Sec. 502 (13))

The following terms are defined in the indicated subparagraphs of 40 CFR 130.2, 1975.

(f) "Water quality management plan" means the plan for managing the water quality, including consideration of the relationship of water quality to land and water resources and uses, on an areawide basis, for each EPA/State approved planning area and for those areas designated pursuant to section 208a (2), (3), or (4) of the Act within a State.

(g) The term "State planning area" means that area of the State that is not designated pursuant to section 208(a) (2), (3), or (4) of the Act.....Depending upon the requirement being considered, the State planning area may be subdivided into "approved planning areas" that may include the entire State or portions of the State defined by hydrologic, political, or other boundaries.

(h) The term "designated areawide planning area" means all areas designated pursuant to section 208(a) (2), (3), or (4) of the Act and § 130.13.

(o) The term "segment" means a portion of an approved planning area, the surface waters of which have common hydrologic characteristics (or flow regulation patterns); common natural physical, chemical and biological characteristics and processes; and common reactions to external stresses, such as the discharge of pollutants.

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16. ABSTRACT

The report is designed as a manual to evaluate the efficiency of surface-water quality monitoring networks whose primary objective is to document compliance with or progress toward attaining ambient water quality standards. The manual provides methods to evaluate the efficiency of each of seven operational areas: Network Plan and Design, Personnel, Facilities and Equipment, Sampling Quality Assurance, Data Distribution and Dissemination, and Agency Interactions. A technique is presented for the overall integrated evaluation of the operational areas. A final section provides methods to evaluate the efficiency of budgetary allocations.

17. KEY WORDS AND DOCUMENT ANALYSIS

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