NWRI CONTRIBUTION 90-115

SUMMARY REPORT FOR UGLCC INTERLABORATORY STUDIES ON THE ANALYSIS OF PCBs IN WATER AND STANDARD SOLUTIONS

by

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March 1990

MANAGEMENT PERSPECTIVE

The Upper Great Lakes Connecting Channels (UGLCC) have been designated as "Areas of Concern" by the International Joint Commission. A Canada-U.S. binational study involving the identification and assessment of the environmental impacts of toxic substances in those areas was initiated in late 1985. In order to assist participating analytical laboratories, to generate reliable and accurate data during the study, a Date Quality Management Work Group was formed and 13 interlaboratory performance evaluation studies were initiated.

Final reports for the 13 interlaboratory studies have been completed. This report presents a summary of interlaboratory studies QM-1 and QM-7 on the analysis of PCBs in water and standard solutions contained in ampules. The information contained in this report will assist project leaders, managers and users of UGLCC data in evaluating the performance of participating laboratories.

Dr. J. Lawrence
Director
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PERSPECTIVE DE GESTION

La Commission mixte internationale a déclaré que les voies d'eau de communication du bassin supérieur des Grands Lacs constituent des zones préoccupantes. Vers la fin de 1985, on a amorcé une étude américano-canadienne afin de déterminer et d'évaluer les répercussions environnementales des substances toxiques dans ces régions. On a mis sur pied un Groupe de travail sur la qualité des données et amorcé 13 études interlaboratoires permettant d'évaluer les résultats, afin d'aider les laboratoires d'analyse participant à cette étude à fournir des données fiables et exactes.

Les rapports définitifs de ces 13 études ont maintenant été rédigés. Le présent rapport fournit un résumé des études interlaboratoires QM-1 et QM-7 qui ont analysé le taux de BPC de l'eau et des solutions contenues dans des ampoules. Ce document aidera les responsables de projet, les directeurs et ceux qui se servent des résultats de l'Étude sur les voies d'eau de communication du bassin supérieur des Grands Lacs à évaluer les résultats obtenus par les laboratoires participants.

J. Lawrence
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ABSTRACT

In the early planning stages of the Upper Great Lakes Connecting Channels (UGLCC) Study, it was recognized that quality assurance/quality control (QA/QC) aspects would be crucial to the overall usefulness of the study results. In order to address this matter, a Data Quality Management Work Group was established and thirteen interlaboratory performance evaluation (PE) studies for inorganic and organic parameters were designed and conducted throughout the duration of the UGLCC study (1985 - 1987).

Final reports for the 13 interlaboratory studies have been completed. Results from interlaboratorry PE studies Nos. QM-1 and QM-7 on the analysis of PCBs in water and standard solutions contained in ampules are now integrated into this report. The information contained in this report will assist project leaders, managers and users of UGLCCS data in evaluating the performance of participating laboratories.

RÉSUMÉ

Lors de la préparation de l'Étude sur les voies d'eau de communication du bassin supérieur des Grands Lacs, on a établi que les résultats de l'étude ne seraient utiles que si les données répondaient à des critères stricts d'assurance et de contrôle de la qualité. Par conséquent, on a mis sur pied un Groupe de travail sur la qualité des données et amorcé 13 études interlaboratoires destinées à évaluer les résultats et portant sur les paramètres inorganiques et organiques. Ces études ont été menées parallèlement à l'Étude sur les voies d'eau de communication du bassin supérieur des Grands Lacs (1985-1987).

Les rapports définitifs de ces 13 études sont terminés. Le présent rapport contient maintenant les résultats des études interlaboratoires nº QM-1 et QM-7 sur le montant de BPC de l'eau et des solutions normales contenues dans des ampoules. Ce document aidera les responsables de projet, les directeurs et ceux qui se servent des résultats de l'Étude sur les voies d'eau de communication du bassin supérieur des Grands Lacs à évaluer les résultats des laboratoires participants.

1.0 INTRODUCTION

The Upper Great Lakes Connecting Channels Study (UGLCCS) was established to identify and deal with environmental problems associated with the St. Mary's, St. Clair and Detroit Rivers and Lake St. Clair. A three-year, binational study was started in late 1985 and involved Canadian and U.S. environmental and resource agencies.

In the early planning stages of the study, it was recognized that quality assurance/quality control (QA/QC) aspects would be crucial to the overall usefulness of the study results. In order to address this matter, a Data Quality Management Work Group (see Appendix I-A) was established and thirteen interlaboratory performance evaluation studies were conducted.

Thirteen individual final reports on the interlaboratory studies have been completed, as listed in Appendix I-B. This report is a summary of some interlaboratory studies (Nos. QM-1 and QM-7) for PCBs in water and standard solutions contained in ampules. The data accuracy and precision for individual laboratories are discussed as well as data addressing between-laboratory comparability drawn from various studies.

2.0 STUDY DESIGN

At the outset, the Data Quality Management Work Group considered that control of standards and the calibration process (1) were the two most serious sources of variation in results between different laboratories. Therefore, a series of check standards covering all of the UGLCCS parameters for which check standards were available was distributed to laboratories participating in the study.

Table 2.1 provides a listing of the samples distributed for these interlaboratory studies and the constituents to be analyzed covering 36 inorganic and 50 organic parameters. The

participants in these studies included different governmental and private laboratories in both Canada and the U.S., and are enumerated in Table 2.2. The schedule of the QC studies are listed in Table 2.3.

Each study consisted of between four and eight samples which contained either standard solutions in ampules, surrogate spikes for waters, or a limited number of natural reference materials. Test compounds were of fixed concentration for each sample, but levels were made to vary between samples by as much as two orders of magnitude. Most samples were sent out with blind duplicates, so that reproducibility could be assessed. All samples were well-characterized and their stability was verified in advance. Sample stability was also assessed by re-using samples in various studies. This approach has been successfully employed in IJC and LRTAP interlaboratory studies (2,3).

These studies were designed and conducted under the direction of the QA Team of the Research and Applications Branch at the National Water Research Institute in Burlington.

3.0 DATA EVALUATION

In the past, a technique known as Youden ranking (4) was employed to determine bias in a laboratory's results. However, because of the small number of laboratories which provided data, this technique could not be used. As an alternative, each laboratory's result for a particular parameter and a given sample was treated as a 'recovery' and the design value for that parameter and sample was taken as the true value. Percent recoveries for each sample and parameter combination were then calculated and compared to value ranges in the table listed below.

Average or Individual % Recovery	Individual Result Designation (Flag)	Multiple Result Designation (Bias)
≥ 150	Very high (VH)	Very High (VH)
149 - 125	High (H)	High (H)
124 - 76	Satisfactory (S)	Satisfactory (S)
75 - 51	Low (L)	Low (L)
≤ 50	Very low (VL)	Very Low (VL)

In addition to the flagging of individual sample results, bias was also evaluated as an average for all results in a study with the same parameter (i.e. regardless of sample concentration or matrix). The same designation scheme was used as with individual test results (see above).

Appendix II contains a summary of each laboratory's appraisal for flags and bias in various studies.

In these laboratory comparison studies, medians rather than means were preferred for evaluating accuracy of interlaboratory results where there were relatively few data and the means were strongly influenced by outliers. For evaluating precision of interlaboratory results, means and standard deviations were calculated with outliers removed by using Grubb's test (3). The standard deviation (σ) and relative standard deviation (RSD) were calculated as follows:

$$\sigma = \sqrt{(x_i-\bar{x})^2/n-1} \qquad \text{and} \qquad \text{RSD, \%} = \sigma/\bar{x} \times 100$$

where x_i = individual result, $\bar{x}$ = mean,
and n = number of individual results

4.0 RESULTS AND DISCUSSION

4.1 Interlaboratory Comparability

Two studies contained samples which were used for PCB

analysis: QM-1 (January 24, 1986) and QM-7 (March 27, 1986). The participants in these studies are listed in Table 4.1.1. Standard solutions contained in ampules were used as PCB samples in both study QM-1 and study QM-7; additional spiked water samples were used only in study QM-7.

Both studies also included sample duplicates which were used to assess reproducibility within the same laboratory. Appendix III provides a summary of within-lab precision for the analysis of PCBs in various studies.

For traceability of interlaboratory studies, several samples were used in both QM-1 and QM-7. Samples 102/104 in QM-1 and samples 701/702 in QM-7 were identical samples. A summary of the design values and interlaboratory medians for PCBs for these identical samples is given in Table 4.1.2. Figures 4.1.1 presents the percent recoveries of interlaboratory medians for PCBs in these test samples. The agreement of interlaboratory medians in these samples was excellent and percent recoveries of interlaboratory results were all satisfactory within ±25% of the design values in both studies.

The range and average values of percent recoveries of interlaboratory medians for PCBs in various studies are summarized in Table 4.1.3. Figure 4.1.2 presents graphically the range and average values of recoveries of interlaboratory median for PCBs among samples in various studies. Although analysis of PCBs was complicated, the interlaboratory results showed that PCBs were one of the organic parameters conducted by UGLCCS interlaboratory studies for which less scattered results were obtained by participating laboratories. As can be seen from this figure, the interlaboratory results for samples in ampules were comparable and satisfactory with average recoveries within ±10% of the design values in both QM-1 and QM-7 studies. For the spiked water samples in QM-7, the interlaboratory results were less accurate than those obtained for samples in ampules, but the results were still satisfactory with recoveries within ±25% of the design values.

Overall, the accuracy of interlaboratory results for PCBs in ampules and spiked waters was satisfactory in both studies.

Data on the precision of interlaboratory results for PCBs in various studies is summarized in Table 4.1.4. Figure 4.1.3 presents graphically the range and average of RSDs for PCBs among samples in various studies. Average RSDs were less than ±25% for samples in ampules in both QM-1 and QM-7 studies, but it was more than ±25% for spiked water samples in study QM-7.

4.2 Comparison of Laboratory Performance in Various Studies

The key step in evaluating laboratory data is the selection of acceptance criterion. The acceptance criterion used for this report was based on the average of % bias and % flags within a study. This approach was similar to that used by the LRTAP QA program for the evaluation of laboratories involved in the analyses of major ions, nutrients and physical parameters in surface waters (2). This criterion provided a simple way to compare laboratory performance in various studies as shown below:

Average of Percent Bias and Percent Flags	Comment	
≤ 25%	Satisfactory	(A)
26 - 50%	Moderate	(B)
≥ 51%	Poor	(C)

An analysis of the data obtained in various studies for PCBs has been carried out on the basis of the criterion given above and the results are summarized in Table 4.2.1. As shown in Table 4.2.1, few laboratories (U001, U063 and U079) have consistently produced satisfactory results for PCB analysis of both samples in ampules and spiked water samples. Although the PCBs results for samples in ampules were generated satisfactorily by all

participating laboratories, less satisfactory results were generated by several laboratories (U014, U072, U075 and U092) for spiked water samples in study QM-7. The reasons of less satisfactory results for spiked water samples in study QM-7 were attributed to sample preparation involved with extraction, concentration and cleanup steps.

For the evaluation of the relative performance of participating laboratories, the results of each study were summarized in Tables 4.2.2a and 4.2.2b, respectively. These tables provide useful information to project leaders, manager and users of data on the comparability of participating laboratories.

ACKNOWLEDGEMENTS

The authors sincerely thank all participants for their cooperation and Dr. H.B. Lee, E. Kokotich, W. Horn, R. Szawiola, D. Takeuchi, P. Leishman, C. Surette and J. Abbott of the National Water Research Institute for their assistance.

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2. Aspila, K.I. and S. Todd. LRTAP Intercomparison Study L-8: Major Ions, Nutrients and Physical Properties in Water. NWRI Contribution 85-94.
3. Grubbs, E.E. 1969. Procedures for Detecting Outlying Observations in Samples. Technometrics, Vol. II, p. 1-21.
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TABLE 2.1

QC Study Parameters for UGLCC
Interlaboratory Performance Evaluation Studies

Study	Test Samples	Parameters	Substrate
QM-1	4 Ampules	Aroclors	Std. Solutions
	4 Ampules	Chlorinated Insecticides	Std. Solutions
	4 Ampules	Chlorinated Hydrocarbons	Std. Solutions
QM-2	4 Ampules	16 PAHs	Std. Solutions
QM-3	5 Sediments	10 Metals	Sediment CRM or RM
QM-4	4 Waters	23 Major Ions & Nutrients	Water CRM
QM-5	4 Waters	7 Metals	Water CRM
QM-6	4 Sediments	Chlorinated Hydrocarbons	Sediment CRM or RM
	2 Ampules	Chlorinated Hydrocarbons	Std. Solutions
QM-7	2 Ampules	Aroclors	Std. Solutions
	2 Ampules	Chlorinated Hydrocarbons	Std. Solutions
	4 Ampules	Aroclors & Chlorinated Hydrocarbons	Spiking Solutions & Natural Water
QM-8	4 Ampules	Chlorinated Insecticides	Std. Solutions
	4 Ampules	Chlorinated Insecticides	Spiking Solutions & Natural Water
QM-9	4 Waters	Mercury	Water CRM
QM-10	2 Ampules	16 PAH	Std. Solutions
	4 Ampules	15 PAHs	Spiking Solutions & Natural Waters
QM-11	4 Waters	Cyanide	Water CRM
QM-12	4 Waters	Total Phenol	Water CRM
QM-13	2 Ampules	5 Chlorophenols	Std. Solutions
	2 Oils		Fish Oils
	2 Tissues		Fish Tissues

TABLE 2.2
Participants in the UGLCCS Performance Evaluation Studies

U.S. Laboratories

The Bionetics Corporation, (U.S. Environmental Protection Agency - Great Lakes National Program Office), Chicago, Illinois, USA.
Clarkson University, (U.S. Environmental Protection Agency - Large Lakes Research Station, Gross Ile, Michigan), Potsdam, New York, USA.
Detroit Water and Sewerage Department - Analytical Laboratory, Detroit Michigan, USA.
Great Lakes Environmental Research Laboratory - National Oceanic and Atmospheric Administration, Ann Arbor, Michigan, USA.
Michigan Department of Public Health - Centre for Environmental Health Science - Epidemiological Studies Laboratory, Lansing, Michigan, USA.
Michigan Department of Natural Resources, Lansing, Michigan, USA.
Raytheon Service Corporation (U.S. Environmental Protection Agency - Large Lakes Research Station), Grosse Ile, Michigan, USA.
University of Michigan - Great Lakes Research Division, (U.S. Environmental Protection Agency - Great Lakes National Program Office and Great Lakes Environmental Research Laboratory - National Oceanic and Atmospheric Administration) Ann Arbor, Michigan, USA.
U.S. Army Corps of Engineers - Environmental Analysis Branch, Detroit, Michigan, USA.
U.S. Geological Survey - National Water Quality Laboratory, Arvada, Colorado, USA.

Canadian Laboratories

Barringer Magenta Limited, Rexdale, Ontario, Canada.
Beak Analytical Services, Mississauga, Ontario Canada.
Mann Testing Laboratories, Mississauga, Ontario, Canada
National Water Research Institute, Environmental Contaminants Division - Inorganics Section, Burlington, Ontario, Canada.
National Water Resarch Institute, Environmental Contaminants Division - Organics-Pathways Section, Burlington, Ontario, Canada.
National Water Resarch Institute - Environmental Contaminants Division - Organics-Properties Section, Burlington, Ontario, Canada.
Ontario Ministry of Environment, London, Ontario, Canada.
Ontario Ministry of Environment - Inorganic Trace Contaminants Waters Unit, Rexdale, Ontario, Canada.
Ontario Ministry of Environment - Trace Organics Section - Drinking Water, Rexdale, Ontario, Canada.
Ontario Ministry of Environment - Trace Organics Section - Sediment and Biota, Rexdale, Ontario, Canada.
Ontario Ministry of Environment - Trace Organics Section - Wastewater, Rexdale, Ontario, Canada.
Ontario Ministry of Environment - Water Quality Section, Rexdale, Ontario, Canada.
Ontario Ministry of Environment - Thunder Bay, Ontario, Canada.
Wastewater Technology Centre, (Conservation and Protection, Toronto), Burlington, Ontario, Canada.
National Water Quality Laboratory, Burlington, Ontario, Canada.
Zenon Environmental Inc., Burlington, Ontario, Canada.

TABLE 2.3
Interlaboratory Performance Evaluation or QC Studies

UGLCCS QC Study Schedules

Study No.	No. of Questionnaires	No. of Participants	Sent Out Date		Reporting Deadline	No. of Labs Reporting
			Questionnaires	Samples		
QM-1	45	16	Dec. 17/85	Jan. 24/86	Mar 20/86 Closed July 4/86	9
QM-2	45	16	Dec. 17/85	Jan. 24/86	Mar 20/86 Closed July 4/86	7
QM-3	45	15	Dec. 17/85	Jan. 24/86	Mar 20/86 Closed July 4/86	10
QM-4	50	13	Jan. 31/86	Feb. 28/86	Apr. 30/86 Closed Aug. 8/86	10
QM-5	50	14	Jan. 31/86	Feb. 28/86	Apr. 30/86 Closed Aug. 8/86	11
QM-6	50	12	Jan. 31/86	Feb. 28/86	Apr. 30/86 Closed Aug. 8/86	7
QM-7	55	16	Feb. 28/86	Mar. 27/86	May 15/86 Closed Sept 30/86	12
QM-8	55	14	Feb. 28/86	Mar. 27/86	May 15/86 Closed Sept 30/86	10
QM-9	55	12	Feb. 28/86	Mar. 27/86	May 27/86 Closed Sept 30/86	11
QM-10	59	14	Apr. 2/86	May 1/86	May 30/86 Closed Oct. 10/86	9
QM-11	59	10	Apr. 2/86	May 1/86	May 30/86 Closed Oct. 10/86	7
QM-12	59	10	Apr. 2/86	May 1/86	May 30/86 Closed Oct. 10/86	7
QM-13	55	6	May 9/86	Jun. 24/86	Aug. 1/86 Closed Oct. 17/86	2

TABLE 4.1.1

Participants in PCBs Interlaboratory Performance Evaluation Studies

Laboratory Code	Study Number	
	QM-1	QM-7
U001	X	X
U005	X	-
U009	X	-
U013	-	X
U014	X	X
U063	X	X
U072	X	X
U075	X	X
U077	-	X
U079	X	X
U086	X	X
U091	-	X
U092	-	X
U093	-	X

Note X: participated
-: did not participate

TABLE 4.1.2

Interlaboratory Medians for PCBs with Identical Samples in Various Studies

Parameter	Design Value	QM-1		QM-7	
		102	104	701	702
		pg/μL			
PCBs	180	190 (106)	200 (111)	192 (107)	198 (110)

Note: The numbers in parentheses are the percent recoveries of design values.

TABLE 4.1.3

Range and Average Values of Percent Recoveries for PCBs in Various Studies

Parameter	QM-1 (ampules)		QM-7 (ampules)		QM-7 (waters)	
	Range	Average	Range	Average	Range	Average
	%					
PCBs	96.1-111	103(4)	107-110	109(2)	76.3-93.5	84.0(4)

Note: The numbers in parentheses are the number of samples.

TABLE 4.1.4

Precision of Interlaboratory Results for PCBs in Various Studies (RSD)

Parameter	QM-1 (ampules)		QM-7 (ampules)		QM-7 (waters)	
	Range	Average	Range	Average	Range	Average
	%					
PCBs	12.4-20.8	16.8(4)	13.6-17.6	15.6(2)	17.8-41.4	28.9(4)

Note: The numbers in parentheses are the number of samples.

TABLE 4.2.1

Comparison of Laboratory Performance for PCBs in Various Studies

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U001	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.0	0.0	4	0.5	12.5	6.3	A
U005	QM-1	Ampules	1	0.0	0.0	4	1.0	25.0	12.5	A
U009	QM-1	Ampules	1	0.0	0.0	4	0.5	12.5	6.3	A
U013	QM-7	Ampules	1	0.5	50.0	2	0.5	25.0	37.5	B
	QM-7	Waters		NA			NA			
U014	QM-1	Ampules	1	0.5	50.0	4	2.0	50.0	50.0	B
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.5	50.0	2	1.5	75.0	62.5	C
U063	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.0	0.0	4	1.0	25.0	12.5	A
U072	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	1.0	100	4	4.0	100	100	C

TABLE 4.2.1 (continued)

Lab. No.	Study No.	Matrix	Bias			Flags			Average of % Biased and % Flagged	Comment
			No. of Parameters Analyzed	No. of Parameters Biased	% of Parameters Biased	No. of Results Reported	No. of Results Flagged	% of Results Flagged		
U075	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	1.0	100	2	2.0	100	100	C
U077	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.0	0.0	4	1.0	25.0	12.5	A
U079	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.0	0.0	2	0.5	25.0	12.5	A
	QM-7	Waters	1	0.0	0.0	4	1.5	37.5	18.8	A
U086	QM-1	Ampules	1	0.0	0.0	4	0.0	0.0	0.0	A
	QM-7	Ampules	1	0.5	50.0	2	1.5	75.0	62.5	C
	QM-7	Waters	1	0.0	0.0	4	0.5	12.5	6.3	A
U091	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters		NA			NA			
U092	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters	1	0.5	50.0	4	3.5	87.5	68.8	C
U093	QM-7	Ampules	1	0.0	0.0	2	0.0	0.0	0.0	A
	QM-7	Waters		NA			NA			

TABLE 4.2.2a

Summary of Relative Performance of Laboratories for PCBs in Ampules

Lab Code	Average* Performance (%)	Number of Studies	Comment
U001	0.0	2	A
U063	0.0	2	A
U072	0.0	2	A
U075	0.0	2	A
U077	0.0	1	A
U091	0.0	1	A
U092	0.0	1	A
U093	0.0	1	A
U079	6.3	2	A
U009	6.3	1	A
U005	12.5	1	A
U014	25.0	2	A
U086	31.3	2	B
U013	37.5	1	B

Note: * Average Performance (%) is mean value for the average of % biased and % flagged obtained from QM-1 and QM-7.

TABLE 4.2.2b

Summary of Relative Performance of Laboratories for PCBs in Waters

Lab Code	Average of % biased and % flagged (%)	Number of Studies	Comment
U001	6.3	1	A
U086	6.3	1	A
U063	12.5	1	A
U077	12.5	1	A
U079	18.8	1	A
U014	62.5	1	C
U092	68.8	1	C
U072	100	1	C
U075	100	1	C

Fig. 4.1.1 Percent Recovery for PCBs

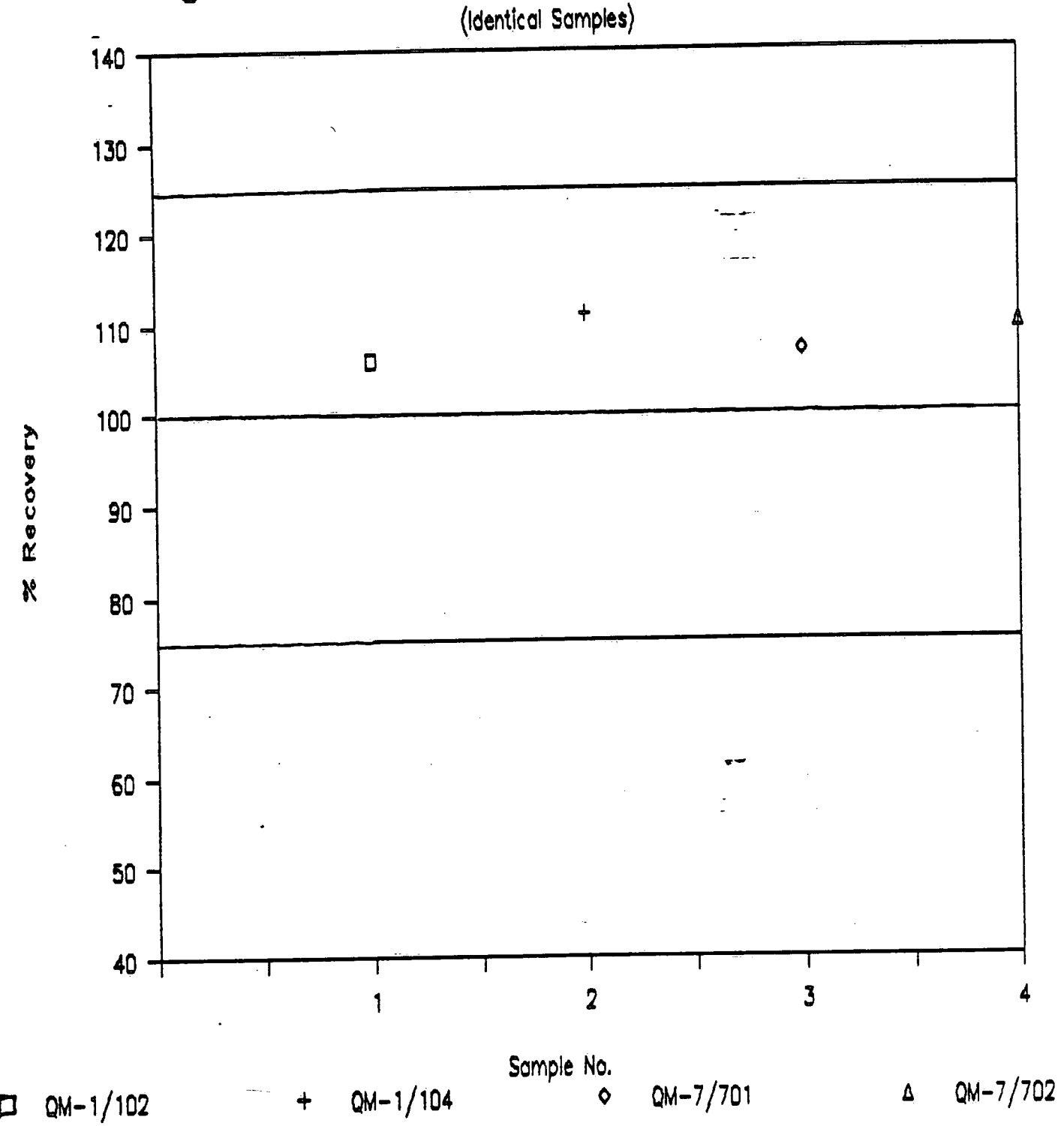


Fig. 4.1.2 Percent Recovery for PCBs

(Various Studies)

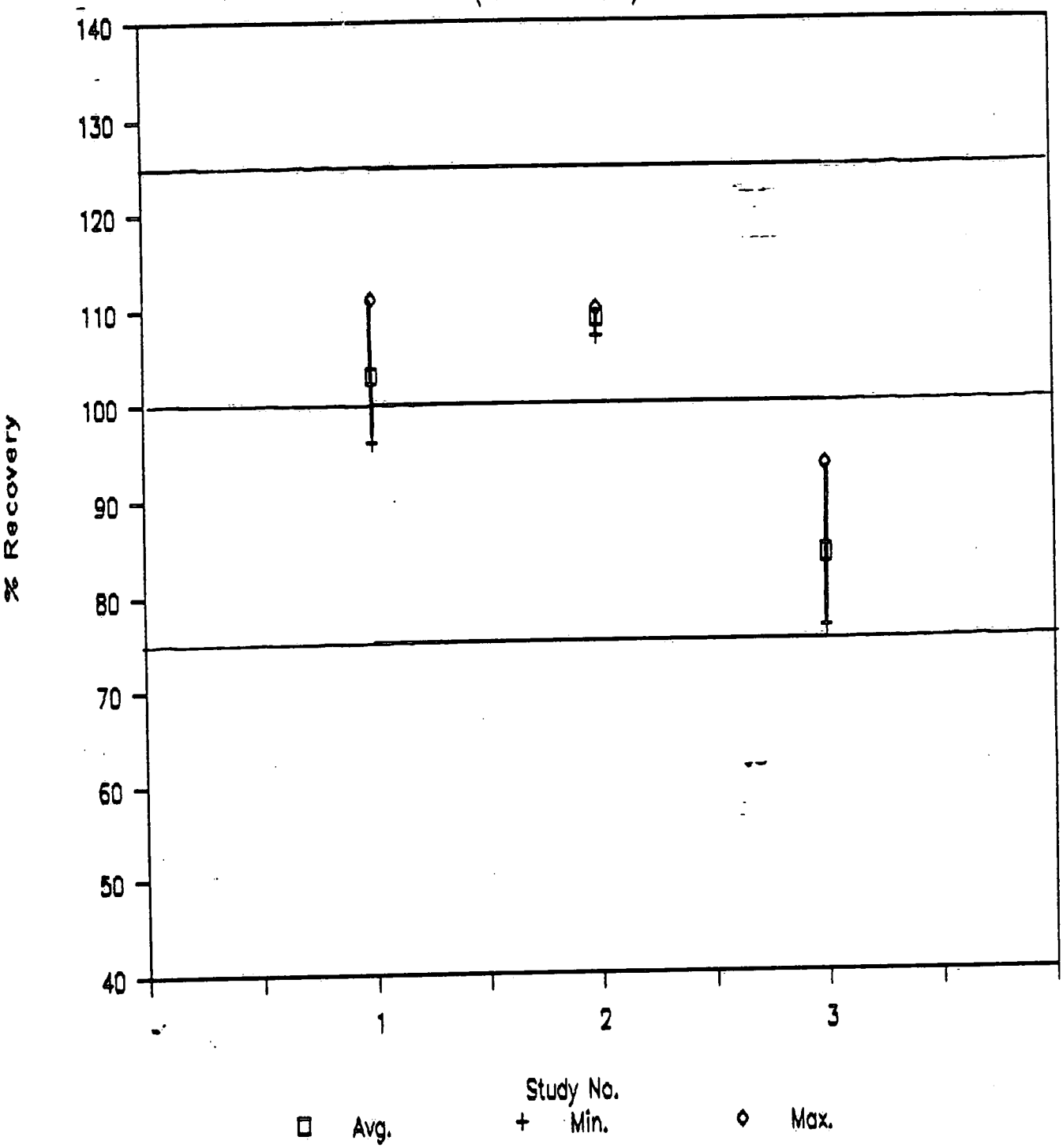
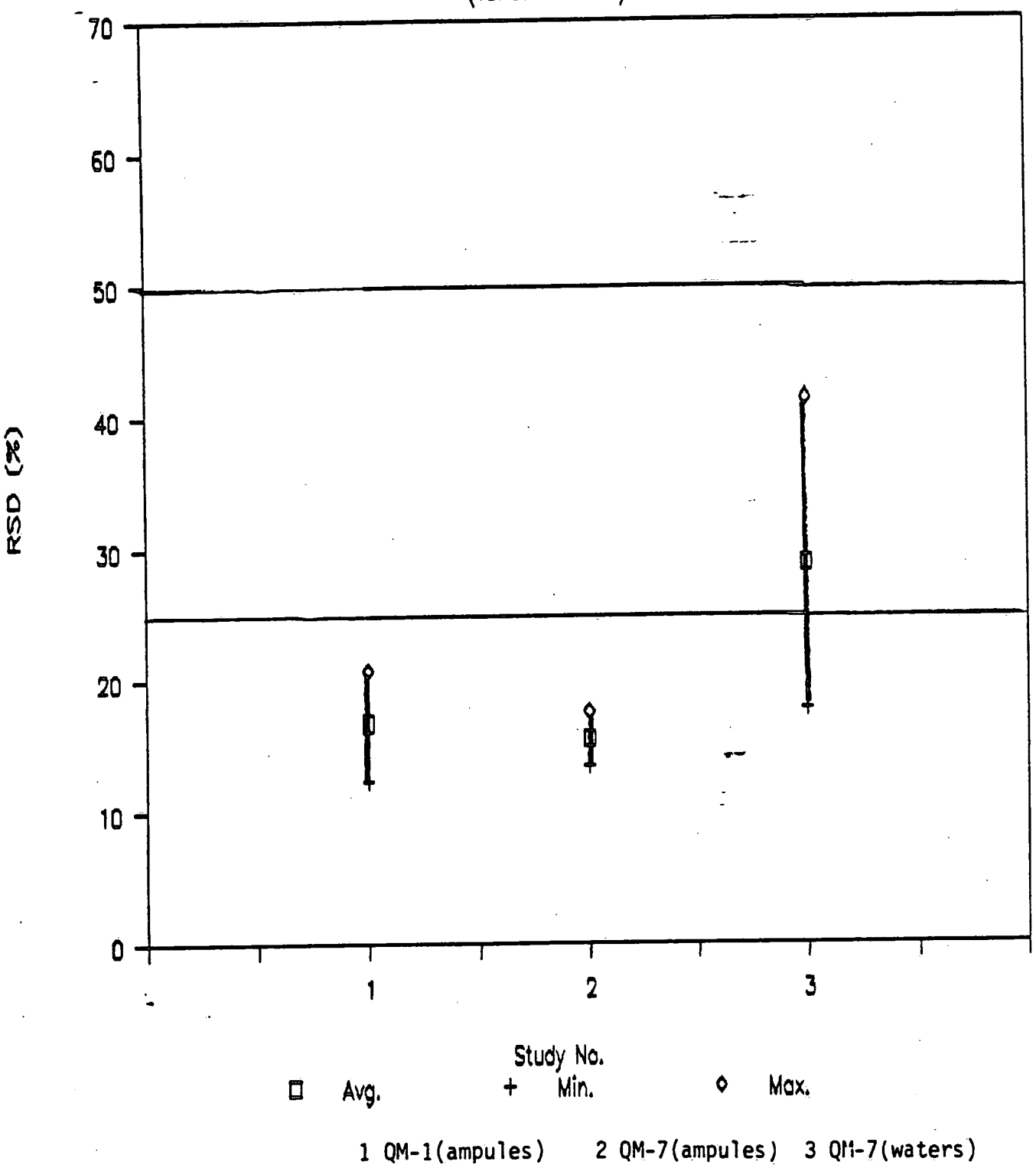


Fig. 4.1.3 RSD for PCBs

(Various Studies)



APPENDIX I-A

DATA QUALITY MANAGEMENT WORK GROUP

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APPENDIX I-B

UGLCCS - FINAL REPORTS

QM-#	TITLE OF FINAL REPORT	AUTHORS
1	PCBs, OCs and CHs in Ampules	W. Horn, R. Szaviola and H.B. Lee and the QMWG
2	PAHs in Ampules	W. Horn, R. Szaviola and H.B. Lee and the QMWG
3	Trace Metals In Sediments	W. Horn, R. Szaviola and H.B. Lee and the QMWG
4	Major Ions In Surface Water	W.A. Horn, R. Szaviola and D. Takeuchi and the QMWG
4	Revised: Major Ions In Surface Water	W.A. Horn, R. Szaviola, D. Takeuchi and P.D. Leishman and the QMWG
5	Trace Metals In Surface Waters	W.A. Horn, D. Takeuchi and R. Szaviola and the QMWG
6	Chlorinated Hydrocarbons In Sediments And Ampules	H.B. Lee, D. Takeuchi and E. Kokotich and the QMWG
7	Chlorinated Hydrocarbons And PCBs In Ampules And Water	R. Szaviola, W. Horn and H.B. Lee and the QMWG
8	Organochlorines In Ampules And Water	R. Szaviola, W. Horn, P. Leishman and H.B. Lee and the QMWG
9	Total Mercury In Surface Water	R. Szaviola, W. Horn and D. Takeuchi and the QMWG
10	PAHs in Ampules and Water	W.C. Li, H.B. Lee and W.A. Horn and the QMWG
11	Total Cyanide In Water	W.C. Li, H.B. Lee and E. Kokotich and the QMWG
12	Total Phenol In Water	W.C. Li, H.B. Lee and E. Kokotich and the QMWG
13	Chlorophenols In Ampules, Fish Oils and Tissues	W.C. Li, R. Szaviola and H.B. Lee and the QMWG

APPENDIX II

Lab-Specific Appraisal for Bias and Flag Statements

II-A: BIAS

LAB-SPECIFIC APPRAISAL FOR BIAS STATEMENTS (PCBs)

Lab Code	QM-1 (ampules)		QM-7 (ampules)		QM-7 (waters)	
	Avg. Rec. (%)	Bias	Avg. Rec. (%)	Bias	Avg. Rec. (%)	Bias
U001	102	S	110	S	84.7	S
U005	123	S				
U009	122	S				
U013			125	H	NA	-
U014	130	H	104	S	53.4	L
U063	90.8	S	112	S	108	S
U072	112	S	105	S	< 17	VL
U075	85.6	S	103	S	< 20	VL
U077			77.8	S	95.4	S
U079	105	S	115	S	116	S
U086	87.3	S	145	H	80.9	S
U091			109	S	NA	-
U092			107	S	59.2	L
U093			97.2	S	NRA	-

II-B: FLAGS

LAB-SPECIFIC APPRAISAL FOR FLAG STATEMENTS (PCBs)

Lab Code	QM-1 (ampules)	QM-7 (ampules)	QM-7 (waters)
U001	-	-	1 L
U005	2 H		
U009	1 H		
U013		1 H	NA
U014	4 H	-	1 L;1 VL
U063	-	-	1 VH
U072	-	-	4 VL
U075	-	-	2 VL
U077		-	1 H;1 L
U079	-	1 H	1 VH;1 H
U086	-	1 VH;1 H	1 L
U091		-	NA
U092		-	3 L;1 VL
U093		-	NA

APPENDIX III

Within-lab Precision

Within-lab Precision for PCBs
(Avg. RSD)

Lab Code	QM-1 (Ampules)	QM-7 (Ampules)	QM-7 (Waters)
	%		
U001	2.0 (2)	1.4 (1)	15.6 (2)
U005	4.4 (2)	-	-
U009	2.7 (2)	-	-
U013	-	1.4 (1)	NA
U014	3.1 (2)	9.4 (1)	8.8 (1)
U063	1.7 (2)	3.8 (1)	18.9 (2)
U072	2.1 (2)	4.0 (1)	3.2 (1)
U075	5.4 (2)	1.9 (1)	-
U077	-	5.7 (1)	16.0 (2)
U079	3.4 (2)	0.0 (1)	10.4 (2)
U086	4.7 (2)	17.8 (1)	1.6 (2)
U091	-	10.9 (1)	NA
U092	-	3.6 (1)	8.2 (2)
U093	-	20.2 (1)	NA

Note: The numbers in parentheses are the number of duplicate pairs.