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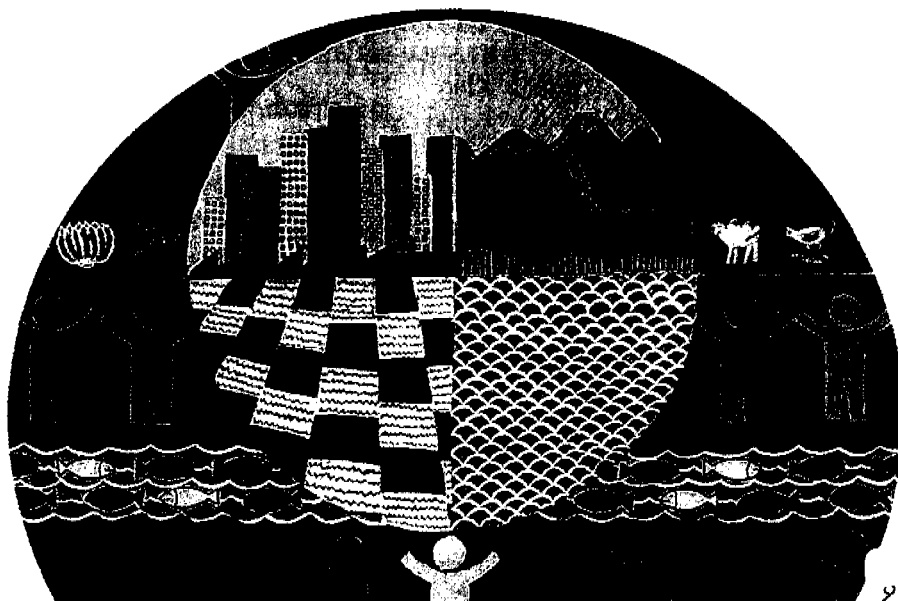
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**Report of Drinking Water Quality
Committee Meeting
Berlin 5-9 June 2000**

Protection of the Human Environment
Water, Sanitation and Health
Geneva
2001



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**REPORT OF DRINKING WATER QUALITY
COMMITTEE MEETING**

BERLIN

5 - 9 JUNE 2000

**Water, Sanitation and Health
Department of Protection of the Human Environment
World Health Organization
Geneva**

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List of Abbreviations

AIT	Asian Institute of Technology, Bangkok
AQC	Analytical Quality Control
AWWSC	American Water Works Service Company, USA
ATSDR	Agency for Toxic Substances and Disease Registry
CDC	Centers for Disease Control and Prevention, USA
CEC	Commission of European Communities
CEN	Comité Européen de Normalisation
CINARA	Centro Interregional de Ambastecimiento y Remocion de Aguas
CICAD	Concise International Chemical Assessment Document (WHO)
DALY	Disability-adjusted Life Year
DHI	Danish Hydraulic Institute
DWI	UK Drinking Water Inspectorate
DWQC	(WHO) Drinking Water Quality Committee
EHC	Environmental Health Criteria document
EMRO	WHO Regional Office for Eastern Mediterranean
EURO	WHO Regional Office for Europe
FAO	Food & Agriculture Organization of the United Nations
GDWQ	(WHO) Guidelines for Drinking Water Quality
GLV	(WHO Drinking Water Quality) Guideline Value
HACCP	Hazard Assessment Critical Control Point
HPC	Heterotrophic Plate Count Bacteria
NEERI	National Environmental Engineering Research Institute (India)
IARC	International Agency for Research on Cancer
IPCS	International Programme on Chemical Safety
ICD	Industry Council for Development
ILC	Inter-Laboratory Comparison
IRC	International Reference Centre (Netherlands)
ISO	International Organisation for Standardisation
IWA	International Water Association
JECFA	Joint FAO/WHO Expert Committee on Food Additives
OECD	Organisation for Economic Cooperation and Development
P&C	Protection and Control (Working Group)
PCS	WHO Programme on Chemical Safety
pGV	(WHO Drinking Water Quality) Provisional Guideline Value
PHLS	Public Health Laboratory Service (UK)
PIC	Prior Informed Consent
POP	Persistent Organic Pollutants
QMRA	Quantitative Microbial Risk Assessment
RIVM	National Institute of Public Health and Environment (Netherlands)
SEARO	WHO Regional Office for South-East Asia
UNHCR	United Nations High Commissioner for Refugees
USEPA	United States Environmental Protection Agency
VITUKI	Research Centre for Water Resources Development (Hungary)
WEDC	Water Engineering Development Centre (UK)
WG	Working Group
WWW	World-Wide Web

1. Background

The first WHO publication dealing specifically with drinking-water quality was published in 1958 as *International Standards for Drinking-water*. It was subsequently revised in 1963 and in 1971 under the same title. In 1984-85, the first edition of the *WHO Guidelines for Drinking-water Quality* was published in three volumes: Vol. 1 – *Recommendations*; Vol. 2 – *Health Criteria and other Supporting Information*; and Vol. 3 – *Surveillance and Control of Community Supplies*. The second editions of the three volumes of the Guidelines were published in 1993, 1996 and 1997, respectively. Addenda to the first and second editions were published in 1998 and 1999, respectively, addressing selected chemicals only. An addendum on microbiological aspects reviewing selected microorganisms is in press.

The primary aim of the *Guidelines for Drinking-water Quality* (GDWQ) is the protection of public health. The GDWQ provide an assessment of the health risk presented by microorganisms, chemicals and radionuclides present in drinking-water. The guideline values recommended for individual constituents of water are not mandatory limits – they are intended to be used in the development of risk management strategies, including national or regional standards developed in the context of local or national environmental, social, economic and cultural conditions. Such strategies, if properly implemented, will ensure the safety of drinking-water supplies through the elimination, or reduction to a minimum concentration, of constituents of water that are known to be hazardous to health.

Volume 3 of the GDWQ: *Surveillance and Control of Community Supplies* is distinct in orientation and is a document oriented towards “good practice”. The present edition is principally focused upon the situation in developing countries. Other “good practice” guidance linked to GDWQ includes, for example, *Toxic Cyanobacteria in water*.

It was agreed in 1995 that the GDWQ would be subject to a rolling revision process. Through this process, microbes and chemicals are subject to periodic review, and documentation related to aspects of “protection and control” of drinking-water quality is progressively prepared. This process was initiated at a meeting of the Coordinating Committee for the Rolling Revision of the WHO Guidelines for Drinking-water Quality, at which three working groups were established. These were to address microbial aspects, chemical aspects and aspects of protection and control of drinking-water quality.

The programme of work of the Microbial Aspects Working Group (WG) was adopted directly by the 1995 Coordinating Committee meeting. The WG met in 1996 (Bad Elster, Germany) and in 1998 (Medmenham, UK). For the period 1996-98, it comprised preparation of selected Microbial Review Documents (MRDs). In its first phase of work, review documents on a number of specific microbes were prepared. A future strategy for major revision of the microbial aspects of the WHO GDWQ, was also developed. The development of an “umbrella approach” to the derivation of guidelines for microbial hazards through water-related exposures including drinking-water, was advanced at an expert consultation in Stockholm, Sweden, in September 1999.

Since the 1995 Coordinating Committee meeting, a series of chemical review documents has been prepared, adopted and published through addenda to the GDWQ as output of the work of the Chemical Aspects WG.

The Protection and Control WG met in 1996 (Bad Elster, Germany) and in 1998 (Medmenham, UK). The Terms of Reference of the WG have been established, and five institutions assist in the coordination of the principal thematic areas of work: resource and source protection (Research Department of the Institute for Water, Soil and Air Hygiene, Bad Elster, Germany); materials and chemicals used in the production and distribution of drinking-water (NSF-International); water treatment (WRc plc, UK) and monitoring and assessment (Robens Centre, UK; VKI, Denmark). All of these institutions are WHO Collaborating Centres concerned with water. A plan of work has been pursued, based initially upon the recommendations of the Coordinating Committee, which has included development of a series of documents principally concerning aspects of “good practice” in achieving the safe conditions described in the GDWQ *per se* and organization of meetings

The overall purpose of this meeting was to plan the process of development of the GDWQ to the third edition, scheduled for publication in 2003, including implications relating to the proposal to apply an overall process of rolling revision thereafter.

The specific objectives of the meeting were:

- To recommend an overall framework for the process of rolling revision and development of the third edition of the GDWQ, including a manual of procedures, with the objective of increasing efficiency, responsiveness, clarity and transparency.
- To recommend an overall approach towards the microbial aspects component of the GDWQ and regarding information and actions needed for the development of clear guidelines in this area.
- To identify priority chemicals for review and prepare explanatory texts for all chemicals considered (whether decided to review or not suitable) for public release.
- To identify technical support information essential to support the derivation of guidelines on microbial aspects and guideline values for chemical constituents.
- To identify high-priority guidance on good practice required to support countries in implementation of the GDWQ.
- To develop a realistic plan of work to lead towards publication of the third edition of the GDWQ in 2003 and to lead into a process of subsequent “rolling revision”.

2. Introductory Session

The meeting was opened by Andreas Grohmann, Institute for Water, Soil and Air Hygiene (WHO Collaborating Centre for Research on Drinking-water Hygiene), who welcomed participants and outlined the work of the Institute. Jamie Bartram described the background and objectives of the meeting and thanked the meeting sponsors, which included the Institute for Water, Soil and Air Hygiene, USEPA and the Ministry of Health and Welfare of Japan.

Following the introduction of the participants, Ingrid Chorus and Guy Howard were elected as chair and rapporteur, respectively. For separate WG sessions, Will

Robertson and Mario Snozzi (Microbiological Aspects); and Kunnath Subramanian and John Fawell with Herman Dieter (Chemical Aspects) were elected as chairs and rapporteurs, respectively. A list of meeting participants is included in Annex 1.

The coordinators of each working group (WG) gave an overview of the status of current work and the progress with the development of materials and documents within the group. In addition to the specific issues within each group, the importance of further developing a transparent approach to the guidelines development in line with WHO policy was emphasized.

3 General recommendations

It was emphasized that the development of end product quality guidelines alone was insufficient to protect public health. Good practice in relation to safe processes is also essential. WHO guidelines should be developed with due consideration to their implementation, and guidance on aspects of good practice is an essential component of this.

Meeting participants recommended that guidelines for health-related water-quality should be placed in the overall context of public health policy and prevention of disease transmission.

3.1 Procedures and "transparency"

The need to further develop transparency in development of the GDWQ was endorsed by the Committee and a procedure to ensure this was reviewed and is documented separately. An important development to support both this and also dissemination and promotion will be use of the WWW, including use to support public domain consultation.

3.2 Format and content

It was recommended that third edition of volume two not be a printed, but that supporting information be made available on the WWW. Recommendations regarding publication format are included as Annex 2 and should be subject to further review as updating proceeds.

The preparation of sections in the GDWQ/Vol. 1 on the application of the guidelines in specific circumstances was considered to be important (Annex 2).

3.3 Materials and chemicals used in production and distribution of drinking water

The 1995 Coordinating Committee meeting identified materials and chemicals used in the production and distribution of drinking-water as one of the principal thematic areas which should be addressed by the Protection and Control WG. The development of a monograph on this theme was adopted by the 1996 WG meeting and work was initiated at a workshop planning meeting in 1997 (report available as

EURO/CP/EHPM 07 01 05). The 1998 WG meeting reviewed progress and endorsed the approach taken, recommending that a consolidated draft be submitted to selected peer-review in late 1998 and an expert meeting be called in early 1999, with the overall objective of peer-reviewed text being available to the next WG meeting.

Meeting participants noted that wider policy discussion was required concerning the approach to contaminants derived principally from materials and chemicals used in the production and distribution of drinking-water. The GDWQ/2nd edition noted that such chemicals were not addressed, since this should be achieved by direct control over the materials and chemicals concerned; nevertheless, guideline values (GVs) were presented for some “additive chemicals”.

Meeting participants noted that, in general, the quality and safety of products used in drinking water production and distribution should be managed by controlling quality and the dosage so that guideline values (GVs) for listed chemicals are not exceeded in the finished drinking water. Thus, it was felt that certain additive chemicals should become candidates for drinking water guidelines in order to guide standard-setting for materials. In presenting such GV's it should be clear whether material quality and/or water quality should be the focus of regulation. Selection of these would be determined on a case-by-case basis, applying usual criteria for selection of chemicals for consideration and would be overseen by the chemical aspects WG.

The draft monograph on the theme was reviewed at the meeting. It provided general guidance on establishment of programmes and background information on some schemes which governments or purchasers might wish to recognize. Meeting participants endorsed the need for such guidance and recommended that the document be aimed at countries that lack a programme of product licensing and wish to develop one. It should not promote particular programmes. It was agreed that a description of selected available programmes in which health concerns were appropriately dealt with be included in the document. It was recommended that the draft document proceed to peer review and a list of reviewers was recommended as: Owen Hydes (DWI, UK), Joyce Donohue, (USEPA, USA); Russ Chaney (World Plumbing Council, USA), Professor Y. Magara (Hokkaido University, Japan), Ans Versteegh, (RIVM/KIWA/Ministry of Environment, Netherlands); German Umweltbundesamt and all WHO Regional Offices.

Further discussion concerned the need for international certification and the appropriateness or otherwise of WHO playing a role in this. Roger Aertgeerts (WHO/EURO) will analyse the options available for WHO to approach certification and make proposals on how to address this at the next meeting of the P&C WG to be taken up by the DWQC if appropriate.

3.4 Toxic cyanobacteria and cyanotoxins

The preparation of a monograph on Toxic Cyanobacteria in Water was recommended by the 1995 Coordinating Committee meeting and its development overseen by the 1996 and 1998 Protection and Control (P&C) WG meetings. An expert consultation was held in 1997, to support its finalization. The final text was released as a WHO co-publication with E&FN Spon in January 1999 and has been well received.

Since publication of the monograph, a significant body of new information has become available. The need for an updated second edition was recognized. The meeting endorsed the proposal of the P&C WG to discuss document updating with selected experts in 2001 informally at the fifth international conference on toxic cyanobacteria in Australia and to develop a programme of work.

It was emphasized that the approach to risk management for cyanobacteria/cyanotoxins should be similar to that for microbial contaminants, with the emphasis on critical control points and prevention of excessive growth of these organisms.

Guideline values for toxins were not the key element in the control strategies. Nevertheless, it was recognized that there was a need for tolerable daily intakes/GVs to be determined for certain toxins to provide support for actions in some circumstances. This aspect will be managed through the chemicals working group, applying usual selection criteria (further discussed in section 5.1 of this report). The issue of approach to control should be included as a footnote in the table that incorporates any GVs for cyanobacterial toxins.

3.5 Dissemination and promotion

In addition to hard copy publication, text of the GDWQ has recently been made available on the WWW. Meeting participants recommended that the GDWQ and associated guidance be made available through the WWW in addition to conventional publication, including translation, wherever appropriate. Meeting participants further recommended that the WWW be used to facilitate access to information on the process of updating of the GDWQ.

Dissemination of the guidelines and of information on the process of their development is important. Developing countries need to have ready access to the guidelines on the web and/or through the WHO Regional Offices.

Dissemination may be further supported by development of the link to the International Water Association and through the development of an electronic newsletter.

Two initiatives have focused on the provision of seminar/teaching materials to support dissemination of the GDWQ, including significant support from the Industry Council for Development (ICD). Meeting participants recommended that they be merged and further developed in response to the revision of the GDWQ.

Considerable legitimate interest in the GDWQ process and products exists in a number of interest groups including, for instance, the water supply industry. Specific outreach activities to enable such interest groups to understand the purpose, process and products, and how to interact with these, should be pursued. Professional and trade associations may be able to provide a suitable interface.

4. Microbial Aspects

4.1 Background

In the present GDWQ (1993), guidelines have not been developed for individual pathogens, and at present, specific information on pathogens is not used for guideline derivation. Instead, general principles are followed: prevention of faecal pollution, and safe practices verified by faecal indicator testing and “sanitary inspection”. The GDWQ emphasize the multiple barrier approach: source water protection, treatment related to source water quality, and maintenance of quality in the distribution system. However, they are often interpreted as end-product standards for *E. coli* only.

The present GDWQ (1993) give end-product standards for faecal indicators (in particular *E. coli*) and turbidity, and operational guidelines for source protection and treatment in general terms. The GDWQ give unequivocal endorsement of disinfection. They indicate that water-quality analysis and sanitary inspection are complementary and that when resources are scarce, it is more important to examine drinking-water frequently by means of a simple test than less often by several tests or a more complicated test.

An outline approach to the updating of microbiological aspects of the GDWQ was developed at a meeting of the Microbial Aspects WG, Medmenham, 1998. Development of a harmonized approach to risk assessment and guideline derivation for microbiological hazards related to water including drinking-water was further advanced at an expert consultation in Stockholm, Sweden, in 1999.

For the derivation and documentation of the guidelines, a number of background documents are needed including those in-hand, described below. The progress with, and approach to needed background documents was reviewed at the meeting and in subsequent discussions with meeting participants; and is summarized below:

4.2 General recommendations

The further development of guidelines on the microbial aspects of water-quality will involve developing an updated approach to the control of microbial contaminants reflecting the significant increase in knowledge within the field since the second edition. This should include the principles of a risk assessment approach, the multiple barrier principle and the development of a HACCP type approach to microbial water quality management throughout the supply chain, from resource to point of use.

Updated microbial guidelines should not consist of a set of compliance values, but the requirement to go through a process of evaluation of the system from the water resources to the point of use. This risk analysis would directly inform assessment of process adequacy. The guidelines would require that, based upon this risk analysis, critical control points and appropriate verifications be identified. Finally, the guidelines would require periodic auditing of procedures and assessment of verifications at appropriate levels. While a customised analysis may be undertaken in some circumstances, under many conditions “model examples” would be required to support implementation and should be included within the GDWQ. The guideline

documents should therefore provide examples of the identification of control points and verifications in a number of scenarios. The scenarios should be selected to ensure wide representativity of the world-wide circumstances.

Microbial aspects of the guidelines should be based on lifetime protection of a normal individual, noting that sensitive sub-populations may require specific guidance.

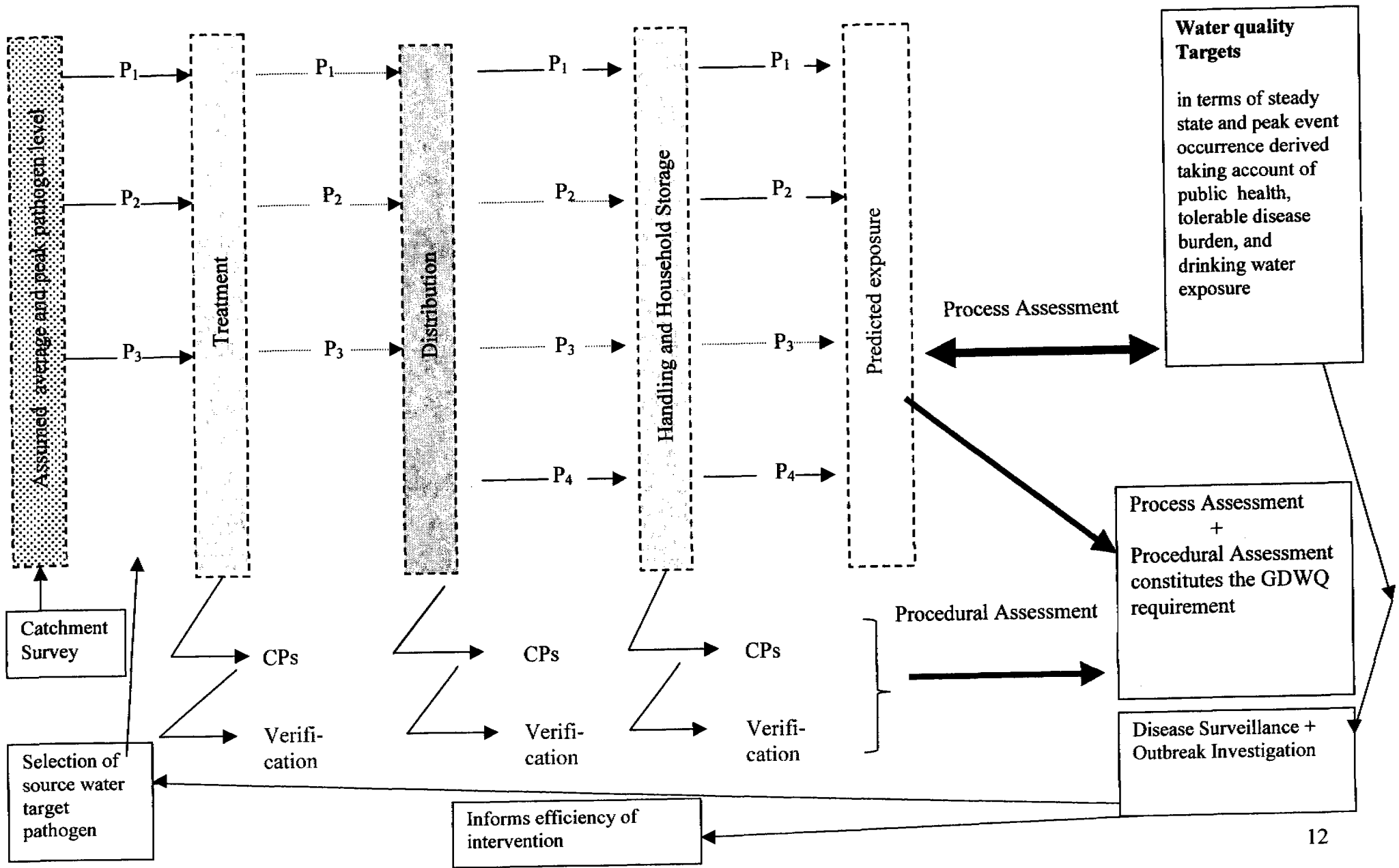
Risk analysis should be appropriate for stepwise implementation and can start, using simple catchment/source surveys and reasonable assumptions about pathogen levels in the source water, their removal within the treatment process, and reintroduction during distribution, storage and handling. This will lead to a first estimate of the drinking-water quality. This process can be refined by including more detailed information about individual pathogens, if available (Figure 1).

Information sources on health risk include epidemiological studies, QMRA, and outbreak investigations. A common exchange unit (such as DALYs) is needed to address tolerable (acceptable) risk in guidelines derivation. Best estimates of risk should be preferred to the use of conservative safety factors in order to better support use of information in economic analysis and local decision-making.

A draft outline document should be prepared and then be reviewed by a small group of experts covering different fields of expertise (microbiology, sanitary or environmental engineering, epidemiology, environmental health, risk assessment, regulation) selected with regional representation. The revised draft should be available for discussion at the meeting scheduled for May 2001 in Australia. (Suggested reviewers: Gerardo Galvis; CINARA, Colombia; Paul Hunter (PHLS, UK); Stig Regli (EPA, USA); Phil Callan (DOH, Australia); Guy Howard (WEDC, UK) and WHO Regional Offices and Regional Environment Centres

Figure 1. WHO Guidelines for Drinking Water Quality Proposed Outline scheme for Microbial aspects in third edition

P_i = pathogen type ($i=1,n$); CP = Control Point



4.3 Pathogen risk assessment

The initial group of waterborne pathogens for which risk assessment documents will be developed was selected because each pathogen has been the cause of drinking-water related disease outbreaks associated with a significant disease burden and because each has certain key typical characteristics that may be used as a reference for understanding risk, risk factors and effective control measures associated with similar pathogens.

- *E. coli* O157/*Shigella* – bacterial pathogen with unknown but presumed moderate infectivity, low environmental persistence, sensitive to disinfection, particularly severe in young children. Measures to control *E. coli* O157 are assumed to be equally effective in controlling *Shigella*, a bacterial pathogen with a high global burden of disease.
- *Cryptosporidium* – relatively small particle, environmentally persistent protozoan pathogen with moderate infectivity and high resistance to chemical disinfection. *Cryptosporidium* is one of the smaller of the protozoan pathogens and the most resistant to chemical disinfection; therefore, measures to control *Cryptosporidium* would also control other protozoan pathogens.
- Enteric hepatitis virus (HAV and HEV) – very small particles, environmentally persistent, moderately resistant to disinfection, with unknown, but presumably high infectivity; HAV assumed to be similar to other enteric viruses, and high severity of disease in the susceptible adult population..
- *Legionella pneumophila* – naturally occurring non-faecal bacterial pathogen that grows rapidly in plumbing systems under the right environmental conditions and poses a health threat via inhalation exposure.

The outline of the risk assessment on *Cryptosporidium* was recognized as an example of the type of information required to inform guideline derivation. There is a need for such documents for a number of selected pathogens only. The documents should follow a common template (Annex 3) to the extent possible.

Suggested lead authors were: John Lee (*Legionella*), Willie Grabow (Hepatitis A or other suitable enteric virus), Peter Teunis, Gertjan Medema et al. (*Cryptosporidium*), Paul Gale (*E. coli* O157/*Shigella*).

Suggested reviewers were:

- Robin Oshiro (USEPA); Christine Moe (University of North Carolina, USA); Pierre Payment (Canada). HAV/Enteric Viruses
- Patrick Grimont (Inst. Pasteur, Paris, France) Paul Berg (USEPA). *E. coli* O157/*Shigella*
- Bill Keevil (UK); Gene Rice (USEPA, Cincinnati, USA). *Legionella*

- Dennis Juraneck (CDC, USA); Kim Fox (USEPA, Cincinnati, USA).
Cryptosporidium

4.4 Microbial testing and indicators

At the GDWQ Working Group on Microbiological Aspects, Medmenham 1998, meeting participants noted the absence of an authoritative review of microbiological indicators in relation to health concerns in drinking water quality; and also noted the material present in Volume 2 of the 2nd Edition of the guidelines. The participants recommended that a review be prepared and it was considered appropriate to target its publication as a free-standing product.

A document is currently being prepared in collaboration with OECD. The document under preparation will aid investigative assessment as well as routine management and covers both new developments in analytical methods and the classical approaches to indicator analysis. The link to the broader context of microbiological quality control through sanitary inspection and physico-chemical monitoring will be noted but not addressed substantively, and was considered to be of importance by the group.

The next stage in guidance development is an expert review in July 2000 at a UK/DWI organised seminar at Basingstoke, UK, then a peer-review process followed by a public domain consultation through an electronic discussion group hosted by OECD. A WHO/OECD expert consultation for technical finalization was scheduled for November 2000. Support for the meeting was to be provided by the Industry Council for Development (ICD) and was gratefully acknowledged.

Many of those involved in the preparation of the document and its peer-review were members of the microbial aspects WG. Ray Morris, Christine Moe (UNC, USA), Paul Beyer (USEPA) and Patrick Grimont (Inst. Pasteur, Paris, France) were proposed as additional peer-reviewers. The roles of HPC testing and of the H₂S test were the topic of frequent enquiries and should be properly addressed.

4.5 Treatment efficiency in pathogen removal and surface water source characterization

At the GDWQ meeting in Medmenham (1998), the need for an expert review of the state of knowledge and available information on treatment efficiency and pathogen removal was identified. It was recommended that the review address disinfection and other treatment processes and that it should emphasize quantitative aspects to the extent possible. It was also noted that the review could become a free-standing publication and serve as a source of information for the development of revisions to the microbial guidelines.

The meeting participants reviewed the draft background document developed by Mark LeChevallier, which provides a review of treatment efficiency in pathogen removal and inactivation. The paper was felt to be of high quality and to have taken this guidance substantially forward.

A few issues were raised as being of importance for inclusion. These included identification of case studies with global applicability, the need to have a section that provides guidance on the integration of processes into a treatment chain, the need for applicability to small and medium supplies, quantitative assessment of reductions in efficiency after filter cleaning and the inclusion of non-conventional forms of treatment. It was agreed that these would be covered and comments should be sent to the author for inclusion. For each process, a list of potential critical control points and, where applicable, monitoring/verification tools should be included.

A revised draft is expected for review at the May 2001 meeting in Australia. The review will be followed by formal peer-review and subsequent review in the public domain.

Peer-reviewers for the document should reflect regional differences and were suggested to include: CINARA, Colombia; VITUKI, Hungary; Prof Ohgaki, University of Tokyo with AIT; NEERI, India; Peter Huck, University of Waterloo, Canada; Chuck Haas, Drexel University, USA; Malay Chauduri, Indian Institute of Technology, Kanpur, India; Dr Endo, NIID, Japan and Dr Dan Smith, University of Alberta, Canada.

Surface source water characterization

It was agreed that a text should be developed that would complement the treatment review by providing guidance for determining the appropriate level of treatment (or the need for intervention in the catchment area) for different source waters, based on easily obtainable information on the characteristics of the watershed.

In addition to an understanding of catchment hydrology and its effect on water quality variability, the framework for assessing source water quality will rely on information from sanitary surveys of the watershed focused on identifying sources of pathogens and the results of research into relevant areas such as the effectiveness of pathogen removal in wastewater processes and characteristics of pathogens that affect their survival in the environment.

The guidance will focus on pathogens that define drinking-water treatment levels, and to the extent that specific information is available also on the reference pathogens with the goal of developing realistic “default” values for pathogen occurrence in a number of scenarios for use in risk assessment and water quality management.

Coordination with the treatment and indicators guidance was seen as essential to ensure consistency.

An initial outline is appended (Annex 4) which was reviewed by members of the microbial aspects WG and the P&C WG following the meeting.

For publication purposes, it was recommended that the possibility of this material being merged with the above on treatment efficiency be considered. A revised draft is expected for review at the May 2001 meeting in Australia. The review will be followed by formal peer-review and subsequent review in the public domain.

Preparation of this text is being lead by Susan Shaw. Peer-reviewers for the document should reflect regional differences and were suggested to include: CINARA, Colombia; VITUKI, Hungary; University of Tokyo with AIT; NEERI, India; Judith Isaac-Renton, University of British Columbia, Canada; Louis Schwarzbrod, Université de Nancy, France; Joan Rose, University of South Florida, USA; Desmond Till, New Zealand and M.LeChevalier, AWWASC, USA.

4.6 Pathogen and indicator attenuation in groundwaters and the efficiency of source protection measures

The development of this text was agreed at the joint meeting of the Microbiology and the Protection and Control Working Groups (Medmenham, 1998). Discussion focused on its importance for the preparation of the 3rd edition of the GDWQ and the need to merge this with the broader guidance on resource protection in preparation by the Protection and Control Working Group. This is further discussed in section 6 (Control of health hazards related to problem source).

4.7 Water quality changes in piped distribution

At the GDWQ Working Group on Microbiological Aspects, (Medmenhan 1998), it was recommended that an issue paper be developed concerning water-quality changes in piped distribution and storage. Relevant issues identified included leakage, low pressure, discontinuous pressure, and discontinuous supply in relation to recontamination of water in the distribution system; good hygiene practice during repair and installation; and microbial growth.

Meeting participants discussed the content requirements of this document and noted that public health-oriented monitoring of microbiological water-quality should be based on that consumed, (i.e. collected from the tap), and not simply water in supply. In addition to the numerous problems noted about water-quality deterioration in distribution caused by system failures, it was important also to consider the problems of maintaining water-quality within drinking-water storage tanks and containers within the home. Recent data had highlighted health impacts and contamination through cross connections, back-siphonage, etc., in addition to ingress.

The following points were noted as critical in the development of this guideline:

- the opportunities for, and development of, sanitary inspection for piped systems;
- identification of critical control points within distribution systems; and
- the approaches to verification of quality.

It was recommended that a draft be ready for the meeting scheduled for May 2001 in Australia, and should when completed be released as a free-standing monograph.

It was agreed that IWA would continue to lead this area and this would be followed up by WHO/HQ. In addition, a number of possible contributors or reviewers were identified: Ray Morris, IWA, UK; Guy Howard, WEDC,UK; Mark LeChevallier (AWWSC, USA); Dick van der Kooij (KIWA, the Netherlands); Ed Geldreich (retired EPA, USA); Ann Kamper, (Montana State University, USA); Stig Regli (EPA, USA);

Jeane-Claude Bloch, University CNRS Vandoeuvre, France; Ken Robert, (USEPA, USA) and Don Reasoner (USEPA, Cincinnati).

4.8 Water quality changes in non-piped distribution and household management; point-of-use devices

The need for guidance in this area especially for developing countries was discussed. Recent evidence of effectiveness of low-cost point-of-use systems in both reducing microbial contamination and in epidemiological evidence of reductions in diarrhoeal disease morbidity in developing countries was highlighted. The effectiveness of some point-of-use systems in arsenic removal was also noted.

Point of use water treatment devices are of public health concern, as a large proportion of the world's population lacks access to an improved water source and because there was demand for guidance for the control of water-quality in point-of-use treatment technologies. The range of point-of-use and point-of-entry treatment, unit processes for small systems and processes for certification were discussed, including a description of USEPA's Environmental Technology Verification (ETV), a cooperative programme with unit process package drinking-water treatment systems manufacturers for generating consensus test protocols and verified performance data. This information will be freely available to regulators, engineers and water system decision-makers for their use in evaluating their technology options

A series of enquiries have been received by WHO from professional and commercial groups relating to health aspects of water softeners, apparently precipitated at least in part by the activities of a CEN Committee.

Meeting participants agreed that the use of low-cost point-of-use systems was an area where guidance was required in the GDWQ 3rd edition. It was suggested that this should be supported by a review of available technologies, mechanisms for promoting sustained use of such technologies and that the epidemiological evidence be provided as a first stage. A policy document was also noted as being of importance and this should link to the review. A distillation of experience should be incorporated into the GDWQ 3rd edition.

Mark Sobsey agreed to take responsibility for developing this text, a draft of which should be available for the May 2001 meeting. An expression of interest to collaborate had been received from Eric Mintz, CDC, USA. WHO/SEARO staff (Han Heijnen) had expressed interest in aspects of point-of-use treatment application to rainwater harvesting. Recommended reviewers included Dr Robert Quick (CDC, USA); Felipe Solsona (WHO/PAHO/CEPIS); Dr Caroline Chang (WHO/PAHO - Ecuador) and Steve Gundry (University of Edinburgh, Scotland).

4.9 Disinfection efficiency

Previous meetings had noted the need for guidance in this area.

It was agreed that the need for guidance on this issue would be adequately covered within three other areas, as follows:

- Piped Water - treatment efficiency document; (section 4.5)
- Non-piped water (section 4.8)
- Water for travellers - guidance document.(section 6.2.5)

4.10 Information on specific pathogens

Readers of GDWQ may expect information on specific pathogens. Since such information is not readily available elsewhere, WHO and IWA agreed to explore the potential for collaboration in this area.

5. Aspects of Chemical Quality

5.1. Background

The current GDWQ (1993) has guideline values (GVs) for 94 chemical parameters. The 1998 addendum added six new parameters as well as updating a number of others.

The Chemical Aspects Working Group met in October 1999 in Geneva and discussed several key issues, including the approach to the rolling process for guideline revision. Particular concern was expressed regarding the need to provide guidance on implementing the large number of chemical parameters.

It was agreed that GV's for chemicals will be based where possible on the internationally peer-reviewed assessments published by the IPCS. In the absence of such an assessment, high quality national reviews should be used as the basis for review.

In all cases, a summary statement (similar to those presently published in GDWQ Vol.1) would be required. The more detailed background presently provided in GDWQ Vol.2 would normally be satisfied by cross-reference to the corresponding IPCS document, with brief further notes on any water-specific or regulatory aspects inadequately covered in the IPCS document. Specific note would be needed in each to indicate whether control of materials and chemicals ("additives") and/or control of water-quality should be the focus of regulation, regarding reasonably achievable analytical limit and regarding achievability through treatment.

Where a risk assessment published by the IPCS was not available, then a more substantive background (similar to those presently published in GDWQ Vol.2) would be required. Meeting participants recommended that these be published as freestanding individual texts to facilitate progressive updating.

Occasionally, it will be found necessary to review a compound for which substantial information exists, but which is commercially sensitive and not available in the public domain. Since processes exist to deal with such situations within the international community through JECFA/JMPR, it was recommended that arrangements be made to deal with such eventualities through these or similar mechanisms.

The WG reviewed the criteria used previously to determine the need to review a chemical for inclusion in the GDWQ and endorsed their continued applicability. These

criteria were applied to all chemicals for which GVs or pGVs had been previously established and to others brought to the attention of the WG. They may be summarized as follows:

- Evidence for occurrence in drinking water.
- Evidence of actual or potential toxicity.
- Significant international concern.

For the purposes of subsequent rolling revision, evaluation of the need to develop or consider updating an assessment would be triggered by:

- For pGVs, any new evidence that might influence provisional status.
- New health risk assessment made available by the IPCS.
- New evaluation of the carcinogenic risk of a chemical by IARC.
- Listing of a chemical in relevant PIC or POP lists.

Agreement to consider substances arising from their use as “additives” is documented in section 3.1 of this report.

The Chemical Aspects WG considered which chemicals for which there are current guidelines might be in need of revision. A small number of additional chemicals for which no guidelines exist were also considered.

5.1 Inorganic Constituents and Substances Affecting Consumer Acceptability

5.1.1 Substances for which there are existing guidelines

Aluminium. Aluminium was included in the 1998 addendum to the Guidelines, with advice on consumer acceptability, but no health-based guideline was derived. At present new data is being generated on health-based issues. The WG considered that the guideline document need not be revised. However, because there is ongoing research, aluminium is a candidate for future review when new data become available.

Ammonium. Ammonium was included in the second edition of the Guidelines based on consumer acceptability considerations. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Antimony. The guideline value for antimony in the second edition of the Guidelines was provisional and, since its publication, new data have emerged. A revised background document for the Guidelines will be prepared. The German Environmental Agency will be requested to nominate a suitable expert to draft the revised document.

Arsenic. A new Environmental Health Criteria (EHC) document is in preparation and studies are in progress. In view of the urgent need for guidance on arsenic, the present background document for the Guidelines will be updated based on the EHC. Arsenic may later be re-evaluated based on results of new studies. The UK Water Research Centre will be requested to nominate a suitable expert to draft the updated guideline document.

Asbestos. Asbestos was evaluated in the second edition of the Guidelines, but no guideline value was derived. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Barium. A new Concise International Chemical Assessment Document (CICAD) is expected in 2000. The WG recommended that the UK Water Research Centre be asked to determine whether the CICAD, when published, contained new information which requires revision of the current guideline.

Beryllium. A new study and a draft CICAD have become available since publication of the second edition of the GDWQ. However, there is still limited data on occurrence. Considering the limited database on toxicity and data on occurrence, the WG considered that it was not appropriate to attempt producing a guideline value for beryllium.

Boron. Boron was included in the 1998 addendum to the Guidelines with a provisional guideline value. Since then, new data have become available, but research is still in progress. The WG considered that the guideline document for boron remained current and should be updated when data from ongoing research become available.

Cadmium. The guideline value for cadmium in the second edition of the Guidelines was based on JECFA PTWI. JECFA re-evaluated cadmium in June 2000. They recommended that the background document for the Guidelines be updated, based on the JECFA re-evaluation. The UK Water Research Centre will nominate a suitable expert to draft the guideline document.

Chloride. Chloride was included in the second edition of the guidelines with guidance on consumer acceptability, but no health-based guideline value was set. The WG was not aware of any new data of significance on chloride and considered that the guideline document need not be revised.

Chromium. The guideline value for chromium in the second edition of the Guidelines was provisional. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Copper. The guideline value for copper in the second edition of the GDWQ was provisional. The WG considered that there were new data available and the background document should be updated. The US Environmental Protection Agency in collaboration with the German Environmental Agency will nominate (a) suitable expert(s) to draft the updated guideline document.

Cyanide. The second edition of the GDWQ includes a review and guideline value for cyanide. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Fluoride. The second edition of the GDWQ includes a review and guideline value for fluoride. The WG noted that an EHC and a monograph on fluoride in drinking-water were being prepared. The background document for fluoride should be updated when these two are completed. The UK Water Research Centre will nominate a suitable expert to draft an updated guideline document.

Hardness. The second edition of the GDWQ includes a review, but no health-based guideline value for hardness. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Hydrogen sulfide. The second edition of the GDWQ contained guidance for hydrogen sulfide, based on consumer acceptability. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Iron. The second edition of the GDWQ contained guidance for iron, based on consumer acceptability. No health-based guideline value was given but indication of an acceptable range of intake based on JECFA PTWI. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Lead. The second edition of the GDWQ includes a review and guideline value for lead. JECFA has re-assessed lead and confirmed the previously derived PTWI. The WG was not aware of any new data of significance and considered that the guideline document need not be revised at this time, but that ongoing research be monitored to decide whether lead would be a candidate for future revision as new studies are completed.

Manganese. The guideline value for manganese in the second edition of the GDWQ was provisional. The WG noted that a CICAD had been published, new data were available and a USEPA evaluation was in progress. The background document for the Guidelines will, therefore, be updated. The Fraúhofer Institute, Germany, will nominate a suitable expert to draft the updated guideline document.

Mercury. The guideline value for mercury in the second edition of the GDWQ was based on a JECFA PTWI for methyl mercury. JECFA has since re-affirmed the PTWI. The WG noted that further work was in progress and a CICAD on inorganic mercury is also in preparation. Mercury is a candidate for future revision when the new data and evaluation become available.

Molybdenum. The second edition of the GDWQ includes a review and guideline value for molybdenum. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Nickel. The guideline value for nickel in the second edition of the GDWQ was provisional. The WG recommended that the Fraúhofer Institute, Germany, investigate if new data to allow reassessment of the guideline value are available and that the UK Water Research Centre nominate a suitable expert to update the background document for the Guidelines as appropriate.

Nitrate/Nitrite. The 1998 addendum to the GDWQ dealt with nitrate and nitrite and established guideline values for each and the relationship between them. The WG was not aware of any new data of significance and considered that the guideline document need not be revised. However, the database for nitrate/nitrite is in need of re-evaluation and it was recommended that JECFA be requested to consider including nitrate and nitrite in its plan of work.

pH. The second edition of the GDWQ had no health-based guideline for pH, but guidance was provided based on consumer acceptability and operational considerations. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Selenium. The second edition of the GDWQ included a review and guideline value for selenium. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Silver. The second edition of the GDWQ includes a review and guideline value for silver. The WG was not aware of any new data of significance and considered that the guideline document need not be revised. Because of apparent increased use of silver as a bacteriostatic agent in water, it is a candidate for future revision.

Sodium. The second edition of the GDWQ contains guidance on consumer acceptability at high concentrations, but no health-based guideline value for sodium. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Sulfate. The second edition of the GDWQ includes a review and a guideline based on consumer acceptability of sulfate. The background document for sulfate will be updated to include a new study, but it is not expected that the new data will cause a change in the guidance given in the second edition of the Guidelines. The UK Water Research Centre will nominate a suitable expert to draft the updated guideline document.

Inorganic tin. In the second edition of the GDWQ, a health-based guideline value for inorganic tin was considered unnecessary. JECFA has since then re-evaluated inorganic tin, but it is unlikely that this will produce a need for derivation of a guideline value. The background document for the Guidelines will be updated based on the JECFA evaluation. The UK Water Research Centre will nominate a suitable expert to update the guideline document to include the JECFA evaluation.

Total dissolved solids. The guidance given in the second edition of the GDWQ is based on consumer acceptability considerations. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

Uranium. The guideline value for uranium in the second edition of the GDWQ was provisional. New studies are about to be completed. A WHO monograph on uranium and depleted uranium is in preparation. Uranium will be a candidate for future revision when these studies and reports become available.

Zinc. The guidance given in the second edition of the GDWQ is based on consumer acceptability considerations. An EHC is currently in press. The WG was not aware of any new data of significance and considered that the guideline document need not be revised.

5.1.2 New inorganic substances for consideration

Strontium. Evaluations of strontium are in progress, but it is uncertain if there will be enough data to allow derivation of a guideline value. Strontium will be a candidate chemical for future revision when the evaluations become available.

Vanadium. Evaluations of vanadium are in progress and a recent CICAD is available, but it is uncertain if there will be enough data to allow derivation of a guideline value. Furthermore, data on occurrence of vanadium are needed. Vanadium will be considered a candidate chemical for future revision when the evaluations become available.

5.2 Organic Constituents

5.2.1 Constituents for which there are existing guideline values.

Chlorinated Alkanes

Carbon tetrachloride. An EHC was published in 1999, which post-dates the 1993 second edition of the GDWQ. This will be used as a basis for updating the guideline. The Fraunhofer Institute, Germany, will be approached to nominate a suitable expert to draft an updated background document.

Dichloromethane. The second edition of the GDWQ includes a review and guideline value for dichloromethane. A JECFA evaluation was published in 1992, and the WG was also aware of new data, which may be significant. Dichloromethane will be a candidate for future revision when these data become available.

1,1-dichloroethane. The second edition of the GDWQ includes a review and guideline value for 1,1-dichloroethane. The WG was not aware of any significant new data and considered that the guideline document need not be revised.

1,2-dichloroethane. This substance is considered as a pesticide. (See pesticides section).

1,1,1-trichloroethane. The second edition of the GDWQ includes a review of this substance and a provisional guideline value. The WG was not aware of any significant new data and considered that the guideline document need not be revised. The German Environment Agency will nominate a suitable expert to update the database and assess any new data.

Chlorinated Ethenes

Vinyl Chloride. The 1993 GDWQ includes a review and guideline value for vinyl chloride. A 1999 EHC post-dates the 1993 guideline and has been published. This guideline will be re-evaluated. The Fraunhofer Institute, Germany, will be approached to nominate an expert to prepare the background document.

1,1-dichloroethene. The 1993 GDWQ includes a review and guideline value for 1,1-dichloroethene. The WG was not aware of significant new data that would alter the 1993 evaluation. A CICAD is to be prepared and this substance will be a candidate for revision when this becomes available. The Fraunhofer Institute will be approached to nominate an expert to prepare the background document at that time.

1,2-dichloroethene. The 1993 GDWQ includes a review and guideline value for 1,2-dichloroethene. The WG was not aware of any significant new data and considered that the guideline document need not be revised.

Trichloroethene. The 1993 GDWQ includes a review and provisional guideline value for trichloroethene. The guideline value was designated as provisional because of uncertainties in the data. IARC has re-evaluated this substance and its carcinogenicity classification has changed from 2B to 2A. The substance will be revised. Health Canada will nominate an expert to draft an updated background document.

Tetrachloroethene. The 1993 GDWQ includes a review document and guideline value for tetrachloroethene. IARC has re-evaluated this substance and changed the carcinogenicity classification from 2B to 2A. The guideline document for this substance will be revised. Health Canada will nominate an expert to draft an updated, background document.

Aromatic Hydrocarbons

Benzene. The 1993 GDWQ includes a review document and guideline value for benzene. The WG was not aware of any significant new data and considered that the guideline document need not be revised.

Toluene. The WG considered that the 1993 GDWQ includes a review document and guideline value for toluene. There appeared to be limited new data on this substance, although since the last update of the GDWQ, ATSDR has re-evaluated its risks. USEPA will nominate an expert to draft an updated background document.

Xylenes. The 1993 GDWQ includes a review and guideline value for xylenes. The WG was not aware of any significant new data at this time and considered that the guideline document need not be revised. It is understood that the OECD is to examine this parameter and xylenes may become a candidate for future revision when this review becomes available.

Ethylbenzene. The 1993 GDWQ includes a review and guideline value for ethylbenzene. The WG was not aware of any significant new data and considered that the guideline document need not be revised.

Styrene. The 1993 GDWQ includes a review and guideline value for styrene. The WG was not aware of any significant new data and considered that the guideline document need not be revised.

Polycyclic Aromatic Hydrocarbons (PAH). There is an existing guideline for **benzo(a)pyrene**, prepared in 1993 and the WG was not aware of any new data that would change this evaluation.

Fluoranthene was considered in 1997 and a guideline value was considered unnecessary. The WG was not aware of any new data that would change this evaluation.

PAHs will not be considered for revision. If data on occurrence in drinking-water indicate the need for additional soluble PAH (apart from benzo(a)pyrene) to be addressed, PAHs will become a candidate for future revision.

Chlorinated Benzenes

The 1993 GDWQ includes a review and guideline value for chlorinated benzenes. The WG was not aware of any significant new data and considered that the guideline document need not be revised.

Miscellaneous Organics

Diethylhexyl adipate and diethylhexyl phthalate. The WG noted that there was significant research into the endocrine disrupting potential and reproductive toxicity of these chemicals in progress. The WG considered it inappropriate to consider these chemicals for revision, but the progress of this research will be kept under scrutiny with a view to determining whether revision of the guidelines will be appropriate at a future date (when their endocrine disrupting potential and the biological consequences are further characterized).

Acrylamide. The 1993 GDWQ includes a review and guideline value for acrylamide. The WG was not aware of any significant new data. However, the Ministry of Health and Welfare, Japan, offered to conduct a review to assess whether relevant new information has emerged.

Epichlorohydrin. The 1993 GDWQ includes a review and provisional guideline value for epichlorohydrin. The guideline value was provisional, due to uncertainties in the database. The WG was aware of new data, but there was uncertainty as to whether this data would significantly alter the guideline value. The Ministry of Health and Welfare, Japan, and the Fraunhofer Institute, Germany, offered to evaluate whether the data are significant and, if so, the Ministry of Health and Welfare, Japan, will nominate an expert to prepare a revised background document.

Hexachlorobutadiene. The 1993 GDWQ includes a review and guideline value for hexachlorobutadiene. The WG noted that there appear to be significant new data on this substance. The Ministry of Health and Welfare, Japan, will nominate an expert to prepare a background document.

EDTA. This substance was revised in the 1998 addendum to the 1993 GDWQ. The WG was not aware of any significant new data and considered that the guideline document need not be revised.

NTA. The 1993 GDWQ includes a review and guideline value for NTA. The WG was not aware of any significant new data and considered that the guideline document need not be revised.

Dialkyltins. The 1993 GDWQ includes a review and guideline value for dialkyltins. The WG noted that there were new data on the reproductive toxicity of dibutyl tin and it will, therefore, be considered for revision. The Ministry of Health and Welfare, Japan, will nominate an expert to prepare a background document for dibutyl tin.

TBTO. A CICAD document was prepared in 1999, but the WG considered that it was uncertain whether the new data are sufficient to permit the derivation of a new guideline

value. The Ministry of Health and Welfare, Japan, will nominate an expert to prepare a background document for TBTO.

5.2.2 New Organic Substances for Consideration

MTBE. The WG noted that this substance is of potential concern in a number of countries and has been recently evaluated in an EHC and by IARC. Most of the data relate to inhalation exposure and research is currently in progress into the comparative pharmacokinetics associated with different routes of exposure. When these data are available, consideration again will be given to the need for the preparation of a guideline.

Petroleum Oils. These mixtures are frequently spilled into water and cause short-term contamination of drinking-water supplies at high concentrations. Evaluations on the composition and toxicity of different fractions of petroleum oils have been prepared in North America and consideration will be given to preparing guidance for use in emergencies.

1,4-dioxane. This substance has been found in drinking-water in several countries and was proposed by Japan for consideration. It is used industrially in significant amounts and has been classified by IARC in group 2B. This substance will be considered for the development of a guideline. In the absence of recent comprehensive reviews by the IPCS, The Ministry of Health and Welfare, Japan, will nominate an expert to draft a new background document.

Nitrobenzene. This substance, and other related substances from munitions, have been identified in water in Germany. An EHC is in preparation and this, with other chemicals related to munitions, will be considered as a candidate for guideline setting when available and when there are more data on how widespread the problem is.

5.3 Disinfectants and Disinfection By-Products

A substantial review of disinfectants and the main by-products has been carried out by IPCS and the corresponding EHC published (EHC 216, 1999). This document will provide the basis for the re-examination of most of the disinfectants and disinfection by-products considered in the second edition of the GDWQ and the addendum to it. In addition, the USEPA has gathered a significant amount of occurrence data. These data will be widely applicable and will be used to update the occurrence data in the background documents, as appropriate.

Bromate, chlorine, chloramine, chlorine dioxide, chlorite, trihalomethanes were considered in the EHC and an update of the guideline will be prepared.

Haloacetates. Dichloro and trichloroacetates, dibromo and bromochloroacetates are considered in the EHC and an update of the guidelines will be prepared. Data are being developed on other haloacetates, but are still limited at this time.

Chloral hydrate. This substance was considered in the EHC and an update of the guideline will be prepared.

Cyanogen chloride. This substance was considered in the EHC and an update of the guideline will be prepared.

USEPA/Health Canada will nominate a suitable expert to draft updated review documents and propose guideline values for all of the above.

Sodium Dichloroisocyanurate. There have been numerous requests to WHO for guidance on the suitability of this stabilised chlorine donor for use in emergencies and other circumstances. The data on this substance are, to an extent, confidential and not in the public domain. It is recommended that this compound be referred to JECFA for evaluation. A background document prepared by the UK is available as a basis for this evaluation.

Iodine. There are concerns over the toxicological aspects of using iodine as a disinfectant in emergency situations and for travellers and detailed guidance is needed. The WG recommended that this compound be referred to JECFA for detailed evaluation. NSF is preparing a toxicological assessment and dose response evaluation document for the US Centers for Disease Control and Prevention and USEPA that will be available by early 2001 and could be made available to the JECFA.

Chlorate. There are a number of new studies on chlorate being carried out in the USA by the National Toxicology Program (NTP) and chlorate will be considered for revision when these data become available.

Haloacetonitriles. There are only limited data on the haloacetonitriles and, therefore, provisional guidelines were proposed in the second edition of the GDWQ. Those for which there are most data are considered in the EHC. An update of the guidelines will be prepared.

A provisional guideline for trichloroacetonitrile was prepared in 1993, but there is evidence that this substance is unstable and is not found at the tap.

The UK Water Research Centre will provide this evidence about trichloroacetonitrile to USEPA. USEPA/Health Canada to prepare draft updated review including statement that there is no need for a guideline value.

Chlorophenols. There appear to be no new data on the chlorophenols and these will not be considered for re-evaluation at this time. However, 2,4,6-trichlorophenol has been proposed for potential research studies in the USA. When such data are available, this substance will be considered for revision.

Formaldehyde. There appear to be no new data that would impact significantly on the guideline, although a CICAD is scheduled for 2001. This substance will not be considered for revision at this time.

Acetaldehyde. No guideline was proposed in 1993 and there is only limited evidence for exposure from drinking-water. It will not, therefore, be considered for evaluation.

Haloaldehydes and Haloketones

Chloroacetaldehyde, 1,1-dichloropropanone, 1,1,1-trichloropropanone, chloroacetone. There are insufficient data to prepare guidelines on these compounds at this time.

MX. There are significant new data available on MX, which was considered in an EHC and an update of the guideline will be prepared by John Fawell, UK Water Research Centre.

Chloropicrin. There appear to be no significant new data on chloropicrin since the 1998 edition of the GDWQ. It will not, therefore, be considered for revision.

Calcium hypochlorite. A proposal was received via the WHO website for the third edition of the guidelines to review calcium hypochlorite. This substance is a chlorine donor, the same as sodium hypochlorite, and is widely used in drinking-water chlorination. It is essentially covered by the data on chlorination and will be mentioned in that context. It is not, therefore, considered necessary to develop a separate guideline value for calcium hypochlorite.

Significant research is in progress on several disinfection by-products, that will need to be considered in future under the rolling revision. These include: Bromodichloromethane (second-generation reproductive study, developmental toxicity studies, lifetime cancer study); Dibromoacetate (second-generation reproductive study, developmental toxicity studies, lifetime cancer study); Bromochloroacetate (second-generation reproductive study); Chlorate (lifetime cancer study); and MX (90-day toxicity and lifetime cancer study).

Monitoring. It is considered undesirable to devote significant resources to monitoring a range of disinfection by-products. The use of indicator parameters that reflect the overall level of disinfection by-products would be of considerable value and it is understood that research to this end is in progress in Canada. Health Canada offered to inform the working group of progress.

5.4 Pesticides

Alachlor: A monograph was published in the GDWQ in 1993. It was not evaluated by JMPR since. Alachlor should be retained in the 3rd edition, and JMPR should be requested to evaluate it as a high priority.

Aldicarb: A monograph was published in the GDWQ in 1993. JMPR has evaluated it in 1995. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Aldrin/Dieldrin: A monograph was published in the GDWQ in 1993. JMPR has evaluated it in 1994. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Ametryn: Has not been listed in the 1993 GDWQ. JMPR should be requested to evaluate it as a high priority.

Amitraz: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1998. It should be included in the 3rd edition based on JMPR's evaluation.

Atrazine: A monograph was published in the GDWQ in 1993. It was not evaluated by JMPR since. It should be retained in the 3rd edition, and JMPR should be requested to evaluate it as a high priority.

Bendiocarb: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Bentazone: A monograph was published in the GDWQ in 1993, and an update in 1998. JMPR has re-evaluated it in 1997 and 1998. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Binapacryl: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Bromophos: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Captafol: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Carbaryl: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1996 and 2000. It should be included in the 3rd edition based on JMPR's evaluation.

Carbofuran: A monograph was published in the GDWQ in 1993, and an update in 1998. JMPR has evaluated it in 1996 and will re-evaluate it in 2002. It should be retained in the GDWQ, and the monograph should be updated after the 2002 assessment. JMPR should be informed about the importance of the compounds for the GDWQ.

Chlordane: A monograph was published in the GDWQ in 1993. JMPR has evaluated it in 1994. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Chlordimeform: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Chlorobenzilate: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Chlorothalonil: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Chlorotoluron: A monograph was published in the GDWQ in 1993. It was not evaluated by JMPR. It should be retained in the 3rd edition, and JMPR should be requested to evaluate it as a low priority.

Chlorpyrifos: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1999. It should be included in the 3rd edition based on JMPR's evaluation.

Cyanazine: Has been included in the 1998 addendum to the GDWQ. It should be retained in the 3rd edition, and JMPR should be requested to evaluate it as a low priority.

Cyfluthrin: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Cypermethrin: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Cypermethrin, alpha-: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

2,4-D (Dichlorophenoxyacetic acid): A monograph was published in the GDWQ in 1993, and an update in 1998. JMPR has re-evaluated it in 1997. It should be retained in the GDWQ, and the monograph should be updated as necessary.

2,4-DB [4-(2,4-dichlorophenoxybutyric acid) (1): A monograph was published in the GDWQ in 1993. It was not evaluated by JMPR. It should be retained in the 3rd edition, but JMPR should not be requested to evaluate it.

DDT & metabolites: A monograph was published in the GDWQ in 1993. JMPR has re-evaluated it in 1997 and 2000. It should be retained in the GDWQ, and the monograph should be updated according to JMPR's latest evaluation.

Deltamethrin: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Diazinon: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

1,2-Dibromo-3-chloropropane (DBCP): A monograph was published in the GDWQ in 1993. It was not evaluated by JMPR. It should be retained in the 3rd edition, but JMPR should not be requested to evaluate it.

Dibromoethane, 1,2- (Ethylene dibromide, EDB): A monograph was published in the GDWQ in 1993, and an update in 1998. JMPR has re-evaluated it in 1994. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Dichloroethane, 1,2- (Ethylene dichloride): A monograph was published in the GDWQ in 1993. JMPR has re-evaluated it in 1994. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Dichloropropane, 1,2-: A monograph was published in the GDWQ in 1993, and an update in 1998. JMPR has not evaluated it. It should be retained in the GDWQ, and JMPR should be requested to evaluate it as a low priority.

Dichloropropene, 1,3-: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the GDWQ, and JMPR should be requested to evaluate it as a low priority.

Dichlorprop (2,4-DP): A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the GDWQ, and JMPR should be requested to evaluate it as a low priority.

Dichlorvos: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Dicofol: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Diflubenzuron: Was not listed in the 1993 GDWQ, nor in the 1998 Addendum. It was evaluated by JMPR in 1994, and is scheduled for reassessment in 2001. It should be included in the 3rd edition based on the most recent JMPR evaluation.

Dimethoate: Was not listed in the 1993 GDWQ, nor in the 1998 Addendum. It was evaluated by JMPR in 1996. It should be included in the 3rd edition based on the most recent JMPR evaluation.

Dinoseb: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Diquat: Has been included in the Addendum to the 1998 GDWQ. It was evaluated by JMPR in 1993. It should be retained in the 3rd edition of the Guidelines based on the current assessment.

Endosulfan: Was not listed in the 1993 GDWQ, nor in the 1998 Addendum. It was evaluated by JMPR in 1998. It should be included in the 3rd edition based on the most recent JMPR evaluation.

Endrin: Was not listed in the 1993 GDWQ, nor in the 1998 Addendum. It was evaluated by JMPR in 1994. It should be included in the 3rd edition based on the most recent JMPR evaluation.

Etofenprox: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Ethylene thiourea: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Fenamiphos: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Fenitrothion: Was not listed in the 1993 GDWQ, nor in the 1998 Addendum. It was evaluated by JMPR in 1988, and re-evaluated in 2000. It should be included in the 3rd edition based on the most recent JMPR evaluation.

Fenoprop (2,4,5-TP; 2,4,5-trichlorophenoxy propionic acid): Was listed in the 1993 GDWQ. It was not evaluated by JMPR. It should be retained in the 3rd edition, but there is no need for a new evaluation by JMPR.

Fenthion: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Fluoroacetamide: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Formothion: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Glyphosate (& its metabolite AMPA): A monograph was published in the GDWQ Addendum in 1998. JMPR has evaluated it in 1986. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Heptachlor/Heptachlor Epoxide: A monograph was published in the GDWQ in 1993. JMPR has re-evaluated it in 1994. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Hexachlorobenzene : A monograph was published in the GDWQ in 1993. JMPR has evaluated it in 1978. It should be retained in the GDWQ, and JMPR should be requested to update the assessment.

Hexachlorocyclohexanes (mixed isomers): Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Iodofenphos (Jodfenphos): Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Isoproturon: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the 3rd edition, but no need for assessment by JMPR was foreseen.

Lindane: A monograph was published in the GDWQ in 1993. JMPR has evaluated it in 1997, and a re-evaluation is scheduled for 2001. It should be retained in the GDWQ, and the monograph should be updated as necessary.

Malathion: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1997. It should be included in the 3rd edition based on the JMPR assessment.

MCPA [4-(2-methyl-4-chlorophenoxy)acetic acid]: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the GDWQ, and JMPR should be requested to evaluate it as a low priority.

MCPB [4(2-methyl-4-chlorophenoxy)butyric acid]: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be deleted from the 3rd edition of the GDWQ.

Mecoprop (MCP; [2(2-methyl-chloro phenoxy propionic acid): A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the GDWQ, and JMPR should be requested to evaluate it as a medium priority.

Methamidophos: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1990. It should be included in the 3rd edition based on the JMPR assessment.

Methomyl: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Methoxychlor: A monograph was published in the GDWQ in 1993. JMPR has evaluated it in 1977. It should be retained in the GDWQ, and JMPR should be requested to evaluate it as a high priority.

Metolachlor: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the GDWQ, and JMPR should be requested to evaluate it as a low priority.

Mirex: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Molinate: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the GDWQ, and JMPR should be requested to evaluate it as a high priority.

Monocrotophos: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1995. It should be included in the 3rd edition based on the JMPR assessment.

Oxamyl: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Parathion: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1995. It should be included in the 3rd edition based on the JMPR assessment.

Parathion-Methyl: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1995. It should be included in the 3rd edition based on the JMPR assessment.

Pendimethalin: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be deleted from the 3rd edition of the GDWQ.

Pentachlorophenol: A monograph was published in the GDWQ in 1993, and an update in the 1998 Addendum. JMPR has not evaluated it. It should be retained in the 3rd edition of the GDWQ, and JMPR should be requested to evaluate it as a medium priority.

Permethrin (added to water): A monograph was published in the GDWQ in 1993. JMPR has evaluated it in 1999. It should be retained in the GDWQ, and the monograph should be updated according to JMPR's assessment.

Phenylphenol, 2- & its sodium salt: Has not been listed in the 1993 GDWQ. JMPR has evaluated it in 1999. It should be included in the GDWQ according to JMPR's assessment.

Phorate: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Phoxim: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Pirimiphos-Methyl: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Propanil: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be deleted from the 3rd edition of the GDWQ.

Propoxur: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Pyrethrins/Pyrethrum: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Pyridate: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be deleted from the 3rd edition of the GDWQ.

Quintozene: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Simazine: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the 3rd edition of the GDWQ, and JMPR should be requested to evaluate it as a high priority.

Temephos: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Terbutylazine: A monograph was published in the Addendum to the GDWQ in 1998. JMPR has not evaluated it. It should be retained in the GDWQ, but no need for a JMPR evaluation was foreseen.

Toxaphene (Camphechlor): Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Triazophos: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

Trichlorfon: Has not been listed in the 1993 GDWQ. It should not be included in the 3rd edition.

2,4,5-Trichlorophenoxyacetic acid (2,4,5-T): A monograph was published in the GDWQ in 1981. JMPR has not evaluated it. It should be retained in the 3rd edition of the GDWQ, and JMPR should be requested to evaluate it as a medium priority.

Trifluralin: A monograph was published in the GDWQ in 1993. JMPR has not evaluated it. It should be retained in the GDWQ, but no need for a JMPR evaluation was foreseen.

New Pesticides for consideration

Dichlobenil: JMPR has not evaluated it. JMPR should be requested for an evaluation (medium priority)

Diuron: JMPR has not evaluated it. JMPR should be requested for an evaluation (medium priority)

Pyriproxiphen: JMPR has evaluated this pesticide in 1999. It should be included in the 3rd edition of the GDWQ based on JMPR's assessment.

6. Aspects of Protection and Control of Drinking-water Quality

The programme of work of the Protection and Control WG comprises a series of issue areas and means to address them, typically through text for inclusion in the GDWQ; development of free-standing texts on aspects of “good practice” and other means.

6.1 Resource and Source Protection

6.1.1 Toxic Cyanobacteria

This issue is addressed in section 3.4 of this report.

6.1.2 Nitrate and Nitrite in Drinking-water and Human Health

This monograph was recommended for finalisation in 1996-1997 by the 1995 Coordinating Committee meeting. The 1996 Working Group meeting endorsed its preparation as a draft in the 1996/97 biennium, for finalisation and publication in 1998/99. The 1998 Working Group meeting reviewed progress and plans and recommended that a revised draft be prepared and circulated for peer-review and revised before submission to the next Working Group meeting.

This monograph covers all aspects of nitrate and nitrite in drinking-water and is in an advanced stage of preparation. The draft was reviewed and discussed by meeting participants and it was recommended that it proceed to peer-review. Reviewers should include Dr Kunikane, NIPH, Japan. It was emphasised that the section on health had been considered in the 1998 addendum and had been prepared through the JECFA process. It will not, therefore, be subject to further peer-review. Finalisation is expected in 2001.

6.1.3 Control of Health Hazards Related to Problem Source

The 1996 WG meeting recommended preparation of a series of documents entitled "Control of health hazards in drinking-water arising from ..." and suggested that four such areas might be progressively addressed. The nature of this initiative and structure of resulting documents was discussed at some length at both the 1996 and 1998 WG meetings with no clear resolution. The 1998 WG meeting encouraged implementation of the proposed international conference in Bad Elster, 24-28 November 1998, as a way forward. The Bad Elster Conference went ahead and its proceedings are available as: Chorus, I.; Ringelband, U.; Schlag, G.; and Schmoll O. 2000: Water, Sanitation and Health - Resolving Conflicts between Drinking-Water Demands and Pressures from Society's Wastes. IWA Publishing in conjunction with Verein WaBoLu. 440 pp.

This remains a priority area and will separately address ground water and surface water aspects. Surface water issues are addressed in this report in section 4.5. Groundwater aspects will be merged with the document concerning pathogen and indicator attenuation in groundwaters and the effectiveness of source protection measures (see also section 4.6). Three aspects requiring guidance were noted as: attenuation of pathogens in the sub-surface; the importance of wellhead protection (sanitary completion); and the broader issues of groundwater management. The Groundwater Monograph outlined in Annex 5 will address these issues.

A draft is expected in time for a small expert meeting in Berlin in February 2001, with possible further review in Australia in May 2001.

6.1.4 Spring protection

Participants in the 1998 WG meeting accepted the suggestion that a simple guidebook on protection of springs as drinking-water sources be prepared since no equivalent readily-available text was known and since resources might become available to support its development.

This meeting recommended that the previous recommendation be satisfied by incorporating relevant information into the groundwater protection text outlined above (Annex 5).

6.2 Materials and Chemicals used in the Production and Distribution of Drinking-Water

6.2.1 Materials Approval and Certification Program

This issue is addressed in section 3.3 of this report.

6.2.2 Guidance concerning water in bottles for consumption

The 1995 Coordinating Committee identified guidance on this theme as a high priority for finalisation in the 1996 - 97 biennium and two WHO Regional Offices (EMRO and EURO) indicated particular interest. The 1996 Working Group meeting noted a number of ongoing activities in the area, in particular by the Codex Alimentarius Commission (CAC). The 1998 Working Group meeting received detailed feedback on the status of CAC activities and decided that in order to avoid duplication of effort, relevant work of the GDWQ Working Groups should be communicated to the corresponding CAC Committees. The 1998 Working Group meeting further recommended that a text be developed for insertion into the 3rd Edition of the GDWQ in due course and that efforts be made to establish coordination with the officials responsible for the relevant CAC Committees. Subsequent discussions between the food and water programmes in WHO-HQ have highlighted potential complementarity between CAC activities and the work of WHO on the GDWQ. A form of words, which accommodates the relevant position of these activities has been proposed and released as a WHO Fact Sheet. It will be submitted to the WG for comment and inclusion in the 3rd edition of the GDWQ.

6.2.3 Management of *Legionella* in Drinking-water Supplies

The microbiological addendum to GDWQ/2nd edition included a microbiology review document on *Legionella*. Meeting participants were concerned that the present guideline did not provide sufficient information about the control of *Legionella*. There are a number of high-quality national reports available. It was, therefore, agreed that a credible national report would be reviewed for possible adaptation to a good practice document, rather than initiate a complete review process. It was agreed that this issue be revisited at a future meeting and was considered to be of moderate priority.

6.2.4. Water hygiene in household plumbing

Improper design and installation of plumbing fixtures in household plumbing systems is a public health concern, especially when drinking-water becomes contaminated with sewage.

An approach had been received from the World Plumbing Council (WPC) to investigate the feasibility of collaborative activity within the field of good practice in plumbing in relation to health protection. In parallel, the Microbiology WG has noted

the need to develop an expert literature review in relation to water-quality changes in distribution to inform the development of the 3rd Edition of the GDWQ.

Meeting participants recommended that the offer of WPC to draft guidance on this be accepted. Coordination with IRC, the Hague, who developed and published an earlier text on this theme, should be established. For consistency, WPC should be aware of ongoing work on Materials and Chemicals used in the production and distribution of drinking-water and be included in the list of reviewers of the corresponding text.

The draft document is expected to be ready by September 2001 and would be subject to the normal review process undertaken as part of the GDWQ revision process. Peer reviewers should include Paul Schwartz, University of South Carolina, USA.

6.2.5 Drinking-water Quality for Travellers

The 1995 Coordinating Committee meeting recommended that the Protection and Control WG consider the needs for guidance concerning drinking-water quality for travellers. The development of this document had been delayed but, based on frequent requests to WHO for advice on this issue, the need to provide guidance with international recognition and because of evidence of health effects, the WG endorsed the need to develop a document on advice to travellers.

A short document and technical review on this theme have been prepared and subjected to limited peer-review. It should go through a further short focused peer-review, including Rodney Cartwright, UK, prior to release to the public domain for comment.

6.3 Drinking-water Treatment

6.3.1 Fluoride in Drinking-water

This document was recommended for finalisation in the 1996-7 biennium by the 1995 Coordinating Committee and this objective was adopted by the 1996 WG meeting. A draft was reviewed by the 1998 WG meeting and recommendations made for finalisation. It was released as a draft for comment in August 1999 with a deadline for comment of end-March 2000.

This monograph is at an advanced stage of preparation and peer-review comments have been received. The EHC on fluoride, which is currently in preparation, will provide the health section and the section on artificial fluoridation, included for completeness, is also linked to the EHC.

Incorporation of comments received concerning health aspects *per se* should be channelled to WHO/PCS to be dealt with in the usual way in EHC development.

The WG emphasised the need for an executive summary and a suggestion was made to consider adding a small section to provide more detailed information on advanced treatment methods. There was a need to ensure that the chemistry of fluorosilicic acid in water is covered in more detail. The group noted that the section on

treatment technology for small supplies required more extensive peer-review and there was also a need for more detailed comment on the decision tree. This would then need to be presented in a more readable form.

John Fawell agreed to complete all revisions to the fluoride monograph except the health section. The health section, because of its linkage to the EHC, will be developed by PCS/WHO.

6.3.2 Review of treatment achievability aspect of chemical review documents

The Protection and Control WG takes responsibility for reviewing “achievability” of health-based guideline values for chemical substances from the point of view of treatment technology. The key contact person in the WG in the first instance is the coordinator for aspects of drinking-water treatment.

6.3.3 Literature on water treatment systems

The 1996 WG meeting noted certain gaps in the available literature on water treatment and also noted the availability of considerable literature on unit processes in drinking-water treatment. The 1998 WG meeting further noted that there was little guidance available on specifying, selecting, operating and controlling the processes that constitute a complete water treatment facility in order to achieve defined water-quality targets. The 1998 WG meeting, therefore, adopted the objective of developing a monograph to address this in close cooperation with the Microbiology WG. WRc agreed to lead its development in coordination with NSF-International with the aim of having a first draft available for discussion at the following Microbiology WG meeting.

The meeting agreed that the need identified above would be satisfied through a) the microbial treatment text (Treatment Efficiency in Pathogen Removal-section 4.5), and b) the treatment achievability of the chemical review documents.

6.3.4 Bankside Filtration

The 1996 Working Group meeting noted the possibility of developing a monograph concerning bankside filtration. The 1998 Working Group meeting reviewed and adopted a proposal for its development. VITUKI offered to coordinate and lead the development of this monograph.

This meeting recommended that the previous recommendation be satisfied by incorporating relevant information into the groundwater protection text outlined above (Section 4.6 and Annex 5).

6.3.5 Arsenic in Drinking-water

The 1998 WG meeting noted that arsenic in drinking-water was a theme of significant concern in several geographic areas and was recognised as a priority issue for health. The meeting adopted the target of production of a monograph on the theme as a high priority. Following the WG meeting, the ACC (the body responsible for coordination among UN agencies) sub-committee on water resources adopted a closely

related objective. Efforts have been made to merge these two initiatives and ensure a single multi-agency product.

The preparation of the monograph is progressing and there was only limited comment from the group, except to stress the importance of this document. The EHC on arsenic is to be linked closely with the key section on health. However, there is a significant risk that a document of great importance for public health in many parts of the world will be delayed due to delays in the completion and publication of the EHC. There is a significant degree of urgency required in the completion of this monograph.

6.3.6 Disinfection Practice

The 1998 Prevention and Control WG meeting proposed the preparation of a monograph on disinfection to update and replace the earlier WRc/WHO monograph and the draft PAHO Reiff and Witt disinfection technology monograph, alongside a risk assessment of disinfectant chemicals by IPCS. WRc and NSF-International originally offered to lead activities in this area and, with WHO, to investigate the feasibility of its development.

The outline presented in the report of the Medmenham meeting remains valid. It was agreed that a specific section should be included that refers to disinfection in emergency situations.

It was recommended that WHO-HQ and PAHO will arrange consolidation of the existing documents into a single guidance volume. Potential authors for a short section on disinfection in emergencies are required. Bob Reed of WEDC was identified as a potential reviewer.

6.3.7 Desalination

WHO periodically receives requests for guidance concerning desalination for drinking-water. No readily-available text on this theme has been identified and literature concerning health aspects has not been considered. It had therefore been proposed that specific guidance be developed. The need for guidance in this area was endorsed by the meeting.

There is a clear public health argument for providing guidance on use of desalinated water for drinking-water. Desalination within particular WHO regions is already common and is increasing rapidly globally. There are likely to be particular chemicals and microbes that would be identified as being of particular importance in desalinated water. Of these, particular concern was expressed regarding the presence of microbes due to blending of final waters which, because they were derived from coastal and marine sources, may not be adequately addressed in the GDWQ. Similar concerns were noted about particular chemicals. It was stressed that any microbes or chemicals, identified as being of particular relevance, that may not be covered by the current GDWQ reviews, should be forwarded to the respective working groups with a recommendation for review.

It was recommended that GDWQ third edition include guidance on applicability of the GDWQ to desalinating systems and that a free-standing monograph also be prepared.

This process will be led by WHO/EMRO, in collaboration with WHO/HQ and other Regional Offices.

6.3.8 Indirect Potable use of Treated Wastewater

The need for guidance in this area is driven by its global relevance. Concern was expressed that care should be taken that WHO was not seen to be endorsing a practice over which there were legitimate health concerns. A review of the state of knowledge about the indirect re-use of treated wastewater, through groundwater, will be completed. This would be prepared by WHO/EURO (Roger Aertgeerts), in cooperation with WHO/HQ (Richard Carr) for review at a forthcoming meeting.

Other aspects of health aspects of wastewater reuse are also in development and are outside the scope of work of the meeting and Committee.

6.4 Monitoring and Assessment

6.4.1 Monitoring of Drinking-water Supply and Quality in Urban Areas

The 1995 Coordinating Committee recommended that guidance on this theme be developed, field tested and revised by the time of preparation of the 3rd Edition of the GDWQ. The 1996 WG meeting agreed to pursue drafting in the 1996-7 biennium. The 1998 WG meeting reviewed plans, especially with regard to identification of pilot projects, and recommended that a small group of experts consolidate draft materials in late 1998.

Pilot projects have been successfully identified to develop materials for dissemination. Within Africa, the Robens Centre and the Water, Engineering and Development Centre (WEDC) initiated a project in Uganda with support from DFID (UK) and as a result produced three manuals. They will now be tested in another African country and in Bangladesh. A parallel activity is underway in Latin America, being undertaken by CEPIS with support from USEPA. It is proposed that these materials be made available on the WEDC-hosted website for comments and collection of additional experience. An expert review meeting will be held in 2001 to review the guidance document. This will lead to a consolidated document dealing with urban areas for the 3rd edition of the Guidelines and inclusion of recommendations within Volume 1. It was recommended the consolidated document be released as a free-standing publication.

It was agreed that Guy Howard, WEDC, UK, would continue to develop this area.

6.4.2 Monitoring and Assessment of Small Community Supplies

Monitoring, assessment and management of small, especially rural, water supply facilities is a universal problem. The 1995 meeting of the Coordinating Committee noted the then recent revision of Volume 3 of the GDWQ and that no new evidence or experience had been forthcoming that would alter the substance or detail of this Volume. It decided that there was no need to initiate changes to Volume 3, but recommended that the WG review this periodically.

The 1998 WG Meeting agreed that Volume 3 of the Guidelines should in due course be slightly expanded in order to also address monitoring, assessment and improvement of small community supplies in intermediate and high-income countries, to balance the low-resource orientation of the present volume.

In addition, it was agreed that the experience of applying the guidance of the current Volume 3 in projects from different regions needs to be collected. This should lead to a revised section in the GDWQ 3rd edition, and into an updated version of the current Volume 3. An offer of cooperation had been received from DWI/UK in relation to treatment of small supply systems and was accepted at the meeting.

Proposals for updating this Volume will be prepared by Guy Howard and Hartmut Bartel for consideration at the next WG meeting.

6.4.3 Health-related Monitoring of Water Quality in Trans-boundary Waters

The need for guidance on this theme was identified at the 1996 WG meeting at which activities in hand by the UN/ECE Task Forces were presented by Martin Adriaanse (water quality) and Peter Literathy (laboratory quality). The 1998 WG meeting agreed to seek establishment of a close working relationship with the relevant UN/ECE Task Forces to ensure the inclusion of health-related issues in documentation concerning trans-boundary waters.

6.4.4 Chemical Contamination – Spills and Exceedences

The 1998 WG meeting noted the intention that the 3rd Edition of the GDWQ would include GVs for short-term exposure to chemicals. It further noted that such exposures result, generally, from accidents (i.e. spillages) and sporadic events. The WG agreed that it should ensure the availability of corresponding guidance on detection, early warning systems, investigation and response to such occurrences. VITUKI and RIZA offered to prepare a review of existing documents, identify gaps and possible overlaps and to propose to the next WG meeting the documentation that might require development.

It was noted that guideline values in the GDWQ were developed for mainly long-term exposure, but WHO had been frequently asked for advice on the interpretation of short-term exceedences of the guidelines in the case of spills, or longer-term small exceedences of the guidelines due to problems such as the geology of the region. It was important to distinguish between these two issues, which required a different approach. This is a substantial area and there are significant difficulties and resource implications

for WHO in providing such advice, while a number of credible organisations had already done work of this type. It was proposed that the NSF - International Collaborating Centre review relevant existing documentation to see if this could provide a body of the required information. The collaborating centre web site could be linked from the WHO site. The NSF International collaborating centre site would provide some background information and list short-term values developed by governments, e.g. USEPA, Germany, or other collaborating centres, e.g. WRc, or link to their web sites as appropriate.

The approach of using the web to provide access to information produced by other credible organizations working in the field of toxicological advice prepared in response to chemical spills to water, was strongly endorsed by the meeting. However, it should be made clear that providing such links did not constitute WHO endorsement of the information provided by, or available through, other organizations.

The UK will nominate an expert to prepare a draft revision of paragraph e of section 1.2 of the 1993 guidelines to address longer-term exceedences of the guidelines with an indication of the need to make plans for appropriate action.

The WHO European Center for Environment and Health, Rome Division, in collaboration with the Italian Government, is currently engaged in the development of a rapid environment and health risk assessment method. The aim of this method is to assess the risk posed to environment and health by continuous and accidental releases of products from active and abandoned industries. A pilot test programme is expected to start in October 2000 and be evaluated by January 2001.

The group also emphasized the need to refer to preparation for emergencies and the need for co-ordination with other WHO groups expert in this field, in particular the Emergencies and Humanitarian Assistance Section (EHA). EMRO and other groups such as WEDC and ECEH-Rome have information and experience on emergency planning that could be made available, as appropriate.

6.4.5 Water quality in emergencies

This area has previously been discussed at the previous Protection and Control WG meetings in Bad Elster (1996) and Medmenham (1998). Progress has been slow, in part due to the need to harmonise work with parallel activities and, in particular, the inter-agency document on *environment and health in emergencies*. This is expected to be published in 2001.

Proposed action relating to water-quality in emergencies has been modified by successive Coordinating Committee and WG meetings in response to improved understanding of the availability of information and requirement for guidance. The 1998 WG meeting agreed that a text concerning the application of the GDWQ in emergencies was required. The 1998 WG meeting also separated this from the need for guidance on disinfection.

It was recommended that the following actions be taken:

- Subsequent editions of the Environment and Health in Emergencies document should be reviewed by the Drinking-water Committee to ensure that water quality issues were adequately addressed and were consistent with the GDWQ.
- Some statement was required in the GDWQ 3rd edition that dealt with the application of the Guidelines in emergency situations. John Fawell agreed to prepare a short (1-2 page) review on the subject for the 3rd edition, ready for the next meeting of the WG on Protection and Control of Water Quality. The reviewers should include José Hueb (WHO).

6.4.6 Quality of Laboratory Data

It was agreed at the 1998 Protection and Control WG Meeting to develop a Code of Good Practice (e.g. 4-5 pages) for laboratory health-related water-quality monitoring and to pursue options for promotion of AQC and ILC. These should make maximum advantage of existing materials and initiatives, such as the GEMS/Water guide on AQC, the UN/ECE Task Force on Laboratory Quality and Accreditation and ISO recommendations.

WHO published the text “water-quality monitoring” in 1996. This book has been well received and it has recently been proposed that it enter a second edition. Meeting participants recommended that the identified information need be satisfied by incorporating, as appropriate, the updated VKI/WHO publication on quality control in water laboratories. This initiative is largely outside the oversight of the WG. The importance of microbiological aspects of drinking-water quality may require additional coverage.

6.4.7 Protocol for chemical monitoring

The current guidelines do not provide sufficient information, especially to poorer countries, to be able to prioritize and select the chemicals that should be included in routine monitoring and assessments. The demand for such guidance is substantial.

The group recommended that an application-focused document be prepared. It was further suggested that the existing document on rapid assessment of land-based sources of pollution be used as a key text. It was agreed that some guidance be included in the 3rd edition of Volume 1, with an additional monograph developed. It was suggested that the latter should be available as close to the publication of the 3rd edition as possible.

An initial document will be developed as outlined in Annex 8, with a first draft expected by late 2000. This would be followed by review at a joint SEARO/WPRO/HQ meeting in Bangkok in January 2001 and then pilot activities in at least two countries. The document would then be revised in light of experience and would also be reviewed at a further meeting in late 2001. Some resources were already available for the development of the protocol, with additional resources being identified to support the field-testing.

The development will be led by SEARO, in cooperation with WHO/HQ, with contributions from Terrence Thompson, John Fawell and Dr. Kunikane. Interest was

expressed by PAHO and EMRO in participating in the process. Further offers of information were provided by EURO and information was also available for Africa from Guy Howard, who also expressed interest in some involvement.

6.4.8 Providing information to the public

There was some discussion of the major issues in public participation and information-sharing highlighted the need for some guidance in this area. A number of scenarios were suggested as to where such guidance was needed. These included:

- boil order notices;
- risk communication and establishing tolerable disease burdens;
- chemicals with acute health effects in emergencies (e.g. reprotoxins); and
- dissemination of general information on water-quality.

In order to initiate development in this area, it was agreed that the first stage would be for experiences to be shared via the web site on monitoring, to be established at WEDC, in order to encourage greater information sharing. These would be provided initially from within the group as short case studies on different procedures. Contributors to include: Owen Hydes, Arie Havelaar, Joe Cotruvo and Roger Aertgeerts.

7. Radiological Aspects

Guidelines on radiological aspects of drinking-water quality on radiological aspects will be prepared by the group responsible for the radiation programme at WHO/HQ. Development of this section should include water experts who can provide appropriate contextual information. The overall process followed should be the same as that employed for other parts of the GDWQ.

Radon will not be dealt with through the GDWQ but a separate, stand-alone document. The meeting recommended that the drafters and reviewers include suitable water experts.

8. Programme of Work

8.1 Working Groups

For purposes of preparation of the 3rd edition of the GDWQ, including preparation for subsequent “rolling revision” the established structure of three working groups and coordinators remained appropriate.

In light of the recommendations of the meeting (and in particular those concerning moving towards improved geographical representation and the need to establish a more formal microbiology WG) and the proposed criteria for WG membership, staff of the WHO Secretariat will approach the following as potential members of the three WGs in the first instance:

Microbial Aspects Working Group

Arie Havelaar, RIVM, the Netherlands (Coordinator).
Willie Grabow, University of Pretoria, S. Africa.
Mark Sobsey, University of North Carolina, USA.
Teechat Boonyakarnkul, Department of Health, Thailand.
IWA specialist group on health-related water microbiology to be routinely invited to attend meetings of the WG.

Chemical Aspects Working Group

Peter Toft, PAHO (coordinator, pesticides).
Ulla Lundt, DHI, Denmark (coordinator, organics).
Ed Ohanian, EPA, USA and Steve Clarkson, Health Canada
(co-coordinators, disinfectants and DBPs).
John Fawell, UK, (coordinator, inorganics).
Yasumoto Magara, Hokkaido University, Japan.

Protection and Control Working Group

Ingrid Chorus, WaBoLu, Germany (coordinator, resource and source protection).
Peter Jackson, WRc, UK.
CINARA, Colombia (tentative, to be approached), (coordinator, treatment).
Joe Cotruvo, NSF-International (coordinator, additives).
Guy Howard, WEDC, UK (coordinator, monitoring and assessment).

WHO coordinators

Jamie Bartram, (WHO/HQ/WSH), Overall GDWQ coordination, microbiological aspects WG; Protection and Control WG.
Peter Toft, (WHO/PAHO), Coordination amongst Chemical WG coordinators for substance review, pesticides coordinator.
Maged Younes, (WHO/HQ/PCS), Risk Assessment.
Hiroki Hashizume (WHO/HQ/WSH), Chemicals aspects implementation documents.
Terry Thompson, (WHO/SEARO), Chemical Monitoring Protocol.
Houssain Abouzaid, (WHO/EMRO), Desalinated Water.
Roger Aertgeerts, (WHO/EURO ECEH), Indirect Wastewater Reuse.
Felipe Solsona, (WHO/PAHO/CEPIS), Monitoring texts.
Ali Basaran, (WHO(WPRO), 2001 Joint Meeting of Chemicals & P&C WGs.

8.2 General Programme of Work

The overall target is for publication of the third edition to be achieved in 2003. Technical finalisation will, therefore, be required in 2002. In turn, most background documentation will be drafted by mid-2001. Outputs of the Protection and Control WG, which will be released as free-standing documents and not inform the GDWQ *per se*, will continue to develop according to their established timetables.

8.2.1 Work Programme Microbial Working Group

The documents that support the development of the Guidelines will be completed in draft and available for expert review and comment at the May 2001 meeting in Australia. Following revision by end of July 2001, the documents will be subject to a three-month peer review; then following revision by January 2002, they are subject to an additional three-month public domain review. The targeted date for completion is June 2002. The document on household plumbing will not be available for the May meeting in Australia (a draft is scheduled for completion by September 2001), however, a draft version should be available to support development of guidelines.

8.2.2 Work Programme Chemicals Working Group

The documents for inorganics and organics will be prepared by the end of October 2001, having undergone limited peer-review. Documents for disinfectants and disinfectant by-products will be prepared for November 2001. All documents must be completed by December 2001 in order to meet the requirement to complete peer-review and public domain review by the third quarter of 2002. It is not intended to produce separate documents for the pesticides to be considered through JMPR, but the short paragraphs for each pesticide to be included require completion by the same time-scale. A joint meeting of the chemicals and protection and control WGs was tentatively scheduled for late 2001.

8.3 Schedule of meetings

- | | | |
|---------------|---|---|
| November 2000 | - | Expert review meeting on draft text on microbial testing and indicators to be hosted by EAWAG, Switzerland, on behalf of WHO and OECD with support from Industry Council for Development (ICD)* |
| February 2001 | - | Microbial attenuation in groundwaters and the efficiency of source protection measures. To be hosted and sponsored by Institute for Water, Soil, Air, and Hygiene, Germany.* |
| May 2001 | - | Joint Meeting on Microbial aspects and P&C WGs, hosted and sponsored by Australia. |
| Late 2001 | - | Meeting of Chemical Aspects WG with WG on aspects of Protection and Control. Hosted by WHO/WPRO; sponsored by Japan. |

* with additional support from USEPA, Japan and Sweden.

LIST OF PARTICIPANTS

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* Invited, but unable to attend

Recommendations regarding publication format

The present content of the Guidelines and associated publications comprises four components:

- the Guidelines *per se*, including information on where to access additional information (broadly corresponds to present Volume 1);
- detailed technical substantiation of Guidelines derivation (presently Volume 2 for chemical aspects); for microbiological aspects there was considerable duplication between Volumes 1 and 2 and limited substantiation of the Guidelines *per se*;
- information on good practice and experience gained in pursuing drinking-water quality; and
- other relevant publications not specifically linked to the GDWQ.

Recommendations of the meeting concerning the layout and content of these are summarised below:

Guidelines *per se*

General

Should remain a WHO publication, in light of normative nature. Single volume also acting as a guide to other texts noted below. More frequent updating and publication than present 10-yearly periodicity.

Microbial aspects

- summary of approach
- off-the-peg hygiene codes
- application on a case-by-case basis

Chemical aspects

- Summary of approach
- Guideline values for chemicals found in drinking water
- Guideline values relating to Additives
- Control of chemicals with acute health effects
- Pesticides added to drinking water

Radiological aspects

Aesthetic aspects (microbial and chemical)

Guidelines application to:

- piped supplies
- small supplies
- point sources (including rainwater catchment)
- desalinated systems
- vessels and aircraft International Health Regulations (vessels)
- water in bottles
- travellers

- emergency situations
- health care facilities
- advice for high-risk groups

Technical Substantiation of Guidelines:

Individual volumes on:

Microbial Aspects

- WHO/OECD text on indicators and analysis;
- Surface water pollution and the efficiency of treatment, including disinfection;
- Attenuation in groundwaters and effectiveness of protection measures
- Water-quality changes in (piped) distribution systems;
- Water-quality changes in handling and households;
- Separate detailed reviews on Specific pathogens (in first Phase to include *Shigella*, *Cryptosporidium*, Hepatitis A virus and *Legionella*)

Publication outlet should be determined based on effectiveness of reaching target audience

Technical Substantiation of Guidelines:

Chemical Aspects

Monographs on individual chemicals (when technical substantiation not published elsewhere, e.g. EHC or CICAD)

Guidance on good practice

Separate volumes on:

- Monograph/briefing note series on individual pathogens;
- Rural monitoring (update of present Volume 3);
- Urban monitoring;
- Groundwater protection;
- Monographs on arsenic, Fluoride and nitrate/nitrite;
- Materials and chemicals used in production and distribution of drinking-water;
- Disinfection practice;
- Protocol on chemical monitoring.

Should be determined based on effectiveness of reaching target audience.

Other documents not exclusively linked to the GDWQ

- Groundwater monitoring (covers both groundwater resources and as drinking-water sources);
- Water-quality monitoring (covers analytical quality control and inter laboratory comparison);
- Toxic cyanobacteria in water (covers drinking-water and recreational water aspects);
- Groundwater recharge with treated wastewater;
- WWW gateway on spills and exceedences;
- Rapid assessment of land-based sources of pollution;
- FAO/WHO activity on hazard characterization of pathogens in food and water;
- Development of harmonized approaches to derivation of guidelines for microbial hazards through water-related exposures.

Purpose of Water-related Pathogen Risk Assessment documents:

To provide information and guidance to risk managers on how to apply the risk assessment framework for:

- Determining a reference level for the pathogen which can be adapted to local circumstances and to develop guidance on how to reach the intended level;
 - Cost / benefits of maintaining or reaching a certain reference level;
 - Prevention / control of epidemic and /or endemic transmission;
- Determine / demonstrate/ verify the level of protection of the population served by a specific water supply;
- Determine management options for adequate control of risk of disease transmission through drinking water.

Target Audience:

Persons responsible for setting standards for drinking water, evaluating adequacy of drinking water quality or water treatment, and /or controlling infectious disease and persons in water utilities responsible for system design, implementation and supervision.

Publication format:

Each document (30 to 50 pages each) should be published separately on the WWW and in a printed version ideally that can be organized and easily updated in a loose-leaf binder. An introductory chapter on microbial risk assessment methodology, HACCP, and application of the information in the documents should precede the pathogen-specific documents. The *Cryptosporidium* documents will provide a detailed example of stochastic analyses in risk assessment; other documents are expected to be more concise.

Content:

Describe risk assessment approach for the reference pathogen, identify critical control points and how each should be evaluated. Provide two or three worked-out typical examples of a risk assessment in different water supply situations where the pathogen poses a potential risk in drinking water. Show the estimate of risk based on the evaluation of critical control points, and discuss potential effectiveness of feasible risk management options.

It is not necessary to use a stochastic approach to the risk assessment (the approach used in the *Cryptosporidium* document) However, when providing a point estimate of risk, it is important to discuss variability and to provide, to the extent that information on the distribution of a key variable exists, a quantitative estimate. In addition, it would be useful to provide some kind of a sensitivity analysis to illustrate which uncertain or variable factors are most important in determining the level of risk and what the effect of variation of their values in a reasonable range would be. The level of detail in the analysis will depend to a large extent on how well different factors are understood. If no adequate data is available, reasonable default values should be suggested and used.

Outline for sample risk assessment / risk management discussions:

1. Introduction and Problem Formulation

Discuss the major issues relating to drinking water-associated disease caused by the pathogen, factors that affect the likelihood of the pathogen being present in drinking water, and how to approach an assessment of risk and evaluate risk management strategies.

2. Hazard Identification

Provide a systematic analysis of factors that contribute to risk of exposure to the pathogen in drinking water. Typical hazards and the likelihood of their occurrence and significance should be documented and clustered into risk scenarios. Such scenarios should include a baseline (“normal” condition) as well as events that are likely to result in peaks of pathogens. In addition to the normal scenario, two or three “event” scenarios could then be selected as additional examples for risk assessment.

3. Exposure Assessment

Drinking water consumption: Discuss population water consumption patterns and use site specific value or distribution, or use default of 1 L/day unboiled.

Pathogen level in drinking water: Discuss feasible approaches to estimating the level and variability of pathogen occurrence in drinking water with a focus on factors that determine water quality at previously identified critical control points.

For individual examples discuss the approach to estimating variability of pathogen occurrence, e.g. peak occurrence events, associated frequency and how, and extent to which, different factors contribute to variability of pathogen exposure.

4. Effect Assessment

Discuss population characteristics and pathogen-host interactions that affect the likelihood of infection, disease, and disease severity. In estimating the health effects associated with a given exposure the vulnerable stages of “normal” life should be considered (e.g. children or adults who might be at higher risk of serious illness), but not the effects of immune system impairing illnesses such as HIV/AIDS. Apply dose response model(s) if available or reasonable assumptions to estimate population risk of relevant health effects. The analysis should consider risk in a previously unexposed population, and to the extent that exposure is known to confer some level of immunity, the analysis could also consider a previously exposed population. If secondary transmission is known to be a major factor in the spread of disease, an approach to estimating its effect could also be discussed.

5. Characterisation of population risk

Discuss health risk inferred from exposure and effect assessments, assumptions, uncertainty, sensitivity of estimate to different assumptions, etc.

6. Risk Management

Evaluation and discussion of risk management strategies and projected levels of risk.

Characterisation of surface-water source water microbial contamination

Objective

To provide guidance on how to estimate or assess the level of microbial contamination in surface-water source waters based on knowledge of the catchment area in order to determine the level of water treatment needed to meet drinking water quality targets.

Scope

The document will present existing information regarding levels of different categories of pathogens (bacteria, viruses, protozoa) associated with different types of activities in the catchment area, discuss hydrologic and climatological factors that affect pathogen transport and survival in the environment, and variability in pathogen levels observed in source water under different conditions. The above information will be applied in the development of a framework for estimating the level and variability of the different categories of pathogens that could be expected to be present in surface-water source water. The estimated pathogen levels may be used as default values for water supply systems that do not have site-specific data on waterborne pathogens and will supplement the guidelines provided in the document on treatment efficiency for estimating the level of pathogens in drinking water.

Target Audience

Persons responsible for setting standards for drinking water, evaluating adequacy of drinking water quality, establishing treatment requirements for drinking water plants and /or controlling infectious disease.

Draft Outline:

- Introduction
- Purpose, context, and how to use the source water characterisation guide
- Presentation of five sample water supplies with well-characterised catchments that will be subsequently be evaluated using the guidelines as examples of guide application.
- Methodological issues in development of the guide
 - What information was considered in developing the default values and how it was analysed, prioritised, what assumptions were made; how, and how much do different factors affect estimates of pathogen levels, definition of average and high-end pathogen levels, normal variability versus extreme conditions, etc.
- Basic informational needs from catchment survey for guidelines application, and approach for putting together the information from the catchment survey in order to develop default pathogen levels / estimate risk. Whether to consider extreme conditions (rare or unpredictable climatological events, spills, waste containment structure failure).
- Default pathogen estimates: Average and high-end estimate of pathogen levels in source water based on pathogen sources, catchment hydrological and climatological characteristics
 - Development of default *Cryptosporidium* / protozoan pathogen contamination level

- Development of default hepatic enteric virus/ viral contamination level
 - Development of default *E. coli* O157 / pathogenic bacterial contamination level
 - Development of default toxic cyanobacteria contamination level
 - Summary tables for each pathogen
- Examples of application of guidance using the five systems previously introduced. Listed below are some suggestions for candidate systems.
 - Watersheds from the New Zealand Study (data on pathogen sources and pathogen occurrence available)
 - Melbourne, Australia; or Portland, Oregon as example of watershed with no human influence?
 - Any well-characterised watersheds in tropical climate?
 - New York City water supply (well-studied watershed with agriculture, sewage treatment plants and non-point sources of pathogens)
 - Quebec water supply (contaminated source, well-studied water quality, high levels of pathogens)
 - Other suggestions?
 - Summary of effectiveness of guide framework to provide an estimate of pathogen levels that is adequate for assessing treatment needs or needs for interventions in the catchment to reduce pathogens, recommendations, caveats, etc.

Groundwater monograph

Title: Groundwater resource and source protection

Objective:

To provide guidance on the protection of groundwater sources and resources to manage water quality.

To present the guidance necessary to support development of the GDWQ.

Scope:

The GDWQ/2nd edition indicate that: "protection of water supplies from contamination is the first line of defence. Source protection is almost invariably the best method of ensuring safe drinking water and is to be preferred to treating a contaminated water supply to render it suitable for consumption." This is an essential component for the critical control point approach being taken during preparation of the 3rd edition in the guidelines for control of microbiological quality of water with respect to characterising source water as a basis both for decisions on management of the catchment area, improving well-head protection and on treatment options.

The guidance is to focus on the following key issues: (1) scientific evidence based review of processes in aquifers and the effectiveness of source protection measures, and (2) review of experience with different approaches to protection of groundwater at local and broader levels. Information on protection and management of groundwater sources used for drinking water supply based on the hazard assessment and critical control point approach will be included in the 3rd Edition, supported by comprehensive coverage of the key issues is to be provided in a free-standing monograph.

Target audience:

Water resource managers, health authorities and environmental health officials, water suppliers, intersectoral authorities

Coordinators:

Ingrid Chorus (UBA), Guy Howard (WEDC, UK), Steve Pedley (Robens, UK).
Reviewers should include VITUKI (Hun); Philip Berger (USEPA); staff of BGS.

Current status:

Around 20 authors have agreed to contribute to the monograph. An editorial meeting is planned to be held by February 2001 in Bad Elster, Germany.

WHO Groundwater Monograph – Table of Contents

1. Introduction
2. Scientific background information
 - 2.1 Hydrological and hydrogeological information and processes
 - 2.2 Transport pathways
 - 2.3 Pathogens: transport, attenuation and survival
 - 2.4 Chemicals: transport, retention, transformation
3. Characterisation of the environment
 - 3.1 Information requirements
 - 3.2 Description of natural conditions in the recharge area
 - 3.3 Anthropogenic activities in the recharge area and their potential hazards
 - 3.4 Socio-economic aspects
4. Situation assessment and critical control points
5. Management measures
 - 5.1 Protection concepts
 - 5.2 Pollution source related measures
 - 5.3 Hydrological management
 - 5.4 Institutional development
 - 5.5 Policy development and implementation
 - 5.6 Community participation
 - 5.7 Legal aspects of protection and management
 - 5.8 Management of extreme situations
6. Verification of critical control points and management measures
7. Summary and conclusions

Protocol on monitoring of chemical constituents of drinking water.

Not all of the chemicals listed in the GDWQ occur in all countries in significant concentrations or with significant frequency. In many countries, many of the chemicals may not occur at all at concentration of significance to human health. In developing national risk management strategies, which may include the development of standards and subsequent monitoring, care should be taken to ensure that resources are not unnecessarily diverted towards substances of relatively minor importance from a health perspective or substances which may not even be present within a particular setting. This is especially true in developing countries.

However, many developing countries lack the resources and experience needed to determine which of the chemicals in the GDWQ should be considered as priorities.

The inability of many developing countries to prioritize chemicals for the purpose of developing risk management strategies for drinking water, points to the need for a simplified, rapid assessment-type protocol which would assist those countries in accomplishing this objective.

The individual approaches taken to date to prioritize chemicals in drinking water have never been assessed in a comprehensive manner, but may fall into the following categories, which are not necessarily exhaustive or exclusive.

- *Screening by laboratory analyses* Anecdotal information indicates that at least some countries in the Caribbean and eastern Europe, and perhaps elsewhere, periodically conduct comprehensive laboratory analyses of water samples in an attempt to determine which chemicals or groups of chemicals are present in drinking water supplies. Subsequent routine monitoring activities focus on the chemicals detected in significant concentrations and frequencies in the screening process.
- *Sanitary surveys.* Simple sanitary survey techniques may be used to gain insight into the chemicals likely to be found in watersheds and recharge areas and even in the water treatment and distribution processes in cases where regulation may be weak.
- *Rapid assessment techniques.* At least one rapid assessment technique already exists which may be used by developing countries to predict which chemicals may be discharged to the environment within a particular setting. *Assessment of Sources of Air, Water, and Land Pollution (WHO/PEP/GETNET/93.1-A)* yields estimations of waste discharges from point sources.
- *Reactive approaches.* Risk management strategies all too often are implemented reactively – rather than proactively - as a result of real or perceived crises, such as disease outbreaks, sometimes precipitated by pressure groups rather than regulatory action. The arsenic crisis in Bangladesh is one notable example.

Objective of the protocol

The objective of the protocol will be to assist developing countries to determine which chemicals may be considered as priorities for the purpose of developing risk management strategies, in the context of drinking water quality surveillance and control.

Features of the protocol

Features of the protocol which may be desirable include:

- The protocol should be user-friendly and based on rapid-assessment techniques suitable for application in developing countries.
- It should be able to assess the likely occurrence of chemicals at the national level and should be useful for the assessment of new water supply sources, and for the planning of routine monitoring programmes for sources, treatment and distribution systems. This may require the separate development of arpedes for the national-, watershed-, and system-level.
- The protocol should help users to determine the chemicals that are predicted to have a high probability of occurrence, so that priorities may be set.
- The relative costs of monitoring different chemicals and the feasibility of controlling those chemicals should be considered.

It is also important that the use of the protocol not lead to static risk management strategies. Rather, it should enable countries to develop increasingly more responsive strategies over time in response to new challenges and as national and local capabilities grow.

Development of the protocol

A small group of experts initially comprising Mr. Terrence Thompson, WHO/SEARO; Dr Shoichi Kunikane, National Institute of Public Health (Japan); and Mr John Fawell, Warren Associates-WRc (UK) will be established to steer the following activities.

- Collect and assess best practices in countries that are undertaking *ad hoc* approaches to prioritizing chemicals. Information will be collected through collaboration with WHO Regional and country offices.
- Document case studies of at least four specific countries that are seen to be particularly relevant.
- Prepare a first draft of the proposed protocol.
- Review and revise the draft protocol in an inter-country workshop (Bangkok, February 2001).
- Conduct test applications of the revised protocol in a minimum of two countries, depending on availability of resources. (Four or more countries would be desirable.)
- Evaluate test applications in a second inter-country workshop and apply lessons learned to a second revision of the protocol.