

WORLD METEOROLOGICAL ORGANIZATION

Weather, Climate and Water

## WORKING GROUP ON HYDROLOGY REGIONAL ASSOCIATION V (SOUTH-WEST PACIFIC)

14-18 December 2009, Bandung, Indonesia



**FINAL REPORT**  
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## **1. OPENING OF THE MEETING**

1.1 The seventh session of the Working Group on Hydrology (WGH) of WMO's Regional Association V (South-West Pacific) (RA V) was held at the premises of the Research Centre for Water Resources (RCWR) in Bandung from 14 to 18 December 2009. The session was organized by RCWR in cooperation with the Meteorological, Climatologically and Geophysical Agency of Indonesia (BMKG). Twenty (20) participants from nine countries in the region (Cook Islands, Fiji, Indonesia, Malaysia, New Zealand, Philippines, Samoa, Solomon Islands, and Vanuatu) attended the meeting. The list of participants is provided in Annex I of this report.

1.2 Mr. John Fenwick from New Zealand, on behalf of the Chairman of the Working Group, Mr Charles Person, welcomed the participants and thanked them for participating in the session. He informed the meeting that due to unforeseen circumstances, Mr Charles Person was unable to join the meeting. He recalled the important role of RA V-WGH in addressing water challenges in the region and the need for strengthening institutional and technical capacity including training of the NHSs in the small islands. He also highlighted the role of RAV-WGH in the development of the Pacific-HYCOS which contributed to improving the NHSs capacity in participating countries. He added that the development of the SEA-HYCOS will complement implementation of Pacific-HYCOS and will complete the participation of all RA V members in the WHYCOS programme. In concluding his remarks, he wished the participants successful deliberations.

1.3 Mr M. Tawfik, on behalf on the Secretary-General of WMO, added his words of welcome to the participants. He expressed WMO's appreciation to the Government of Indonesia and in particular to the RCWR and BMKG for hosting and organizing the meeting and the excellent arrangements. He outlined the purpose and expected outcomes of the meeting.

1.4 Mr Tawfik highlighted challenges facing water managers and outlined the importance of water issues in the region. He informed the meeting about WMO's plan to support the development of the South East Asia HYCOS (SEA-HYCOS). He urged participants to reinforce the role of the Working Group and to ensure that its activities are targeted at the needs of the region. He concluded by assuring the participants of WMO's support for their activities and wished them successful deliberations.

1.5 The meeting was officially opened by Mr Tuwamin Mulyono, Deputy Director General on behalf of Dr Sri Woro B. Harijono, Director General of Indonesia Meteorological, Climatological and geophysical Agency (BMKG) and the Permanent Representative of Indonesia with WMO. He delivered her opening remarks; by joining previous speakers in extending a warm welcome to participants.

1.6 He informed the meeting that organization of the 7<sup>th</sup> RA V-WGH in the Research Centre for Water Resources in Bandung (RCWR) reflects the excellent cooperation between RCWR and BMKG. He noted that the meeting is to strengthen cooperation among interested countries for development of the SEA HYCOS Component, and to review the implementation of the hydrology and water resources programme in relation to the needs of the region.

1.7 He added that the development of SEA-HYCOS, will assist countries in the region in addressing extreme events related to hydrological disasters such as floods, droughts, and tropical cyclones impact and will offer mutual benefits to participating countries.

1.8 He informed the meeting that RCWR is now well established and it has the institutional and technical capacity to provide the required facilities and expertise to the countries in the region to strengthen their national capacity for better management of their water resources and to support

the training needs in the region. He noted that the organization of the Regional Training workshop on Low-Flow Estimation and Predication during the 7<sup>th</sup> RA V-WGH session will provide an opportunity to RCWR to demonstrate its capacity to organize such training activities. Mr Tuwamin Mulyono gave an overview of two BMKG main programs, namely Ina-TEWS (Indonesia Tsunami Early Warning System) and Ina-MCEWS (Indonesia Meteorological Climatological Early Warning System).

1.9 In conclusion, Mr Tuwamin Mulyono confirmed the commitment of the Indonesian government to cooperate with WMO to support RA V member countries in their capacity building programs and to provide the necessary support to the development of SEA-HYCOS. He wished the participants a fruitful meeting and invited them to enjoy their stay in Bandung.

## **2. ORGANIZATION OF WORK OF THE SESSION AND APPROVAL OF AGENDA**

2.1 The meeting agreed on the organization of work for the session and adopted the agenda as given in Annex II. The session was divided into three parts. The first day was devoted to a planning meeting for the development of the SEA-HYCOS; the following two days were allocated for reviewing the work that had been carried out by members of the group and establishing a proposed workplan for future activities to be submitted at the fifteenth session of RA V for consideration. The fourth day was devoted to a training workshop on Low-Flow Estimation and Predication. A full day was allocated for a visit to RCWR facilities and city tour.

2.2 The WMO Secretariat informed the meeting that all the documents had been circulated by email prior to the meeting and offered hard copies of these documents to all participants. The Manual on Low-Flow Estimation and Predication was also distributed to all participants.

### **A. PLANNING MEETING FOR THE DEVELOPMENT OF SEA - HYCOS**

#### **1 Background**

1.1 In response to the need of adequate information systems and to address and solve water problems, WMO initiated the World Hydrological Cycle Observing System, known as WHYCOS. This system helps strengthen national capabilities by a better understanding of the hydrological cycle and thus promote regional cooperation through the exchange of information by using modern technology for data collection and dissemination. The programme has already been implemented successfully through different projects supported by potential donors.

1.2 The WHYCOS is being developed in the form of regional or basin components (HYCOSs) designed to meet regional, basin and national priorities of participating countries and encourage them to exchange meteorological and hydrological data and products and strengthen regional cooperation.

1.3 WMO in collaboration with SOPAC assisted the small islands in the region develop and implement the Pacific-HYCOS. The need of a HYCOS project for South-East Asia was considered at RA V-WGH meetings in 2005 and 2007. Indonesia, Malaysia and Philippines expressed interest in participating in the WHYCOS programme. In response to a request from the government of Indonesia, WMO is considering assisting the countries in the region develop the SEA-HYCOS project. The meeting provided good opportunity to plan for the establishment of the SEA-HYCOS, in order to strengthen the human and technical capacity of National Hydrological Services (NHSs) for water resources management.

## **2. The World Hydrological Cycle Observing System (WHYCOS) and SEA-HYCOS**

2.1 Mr M. Tawfik, made a detailed presentation on the WHYCOS programme. In his presentation, he briefed participants on the background, objectives and development procedures for each HYCOS project. Further, he gave an overview of the project under implementation and WHYCOS Guidelines and Web portal. Finally he highlighted necessary points to be considered in developing SEA-HYCOS.

2.2 Participants noted that WHYCOS is a system for strengthening the national, river basin and regional institutional and technical capacity of water resources management. It aims at promoting cooperation in the collection, transmission, processing, archiving and use of hydrological data and information. WHYCOS consists of a number of different components (HYCOS), each independently developed, implemented and responsive to national and regional/basin needs. It address the needs and requirements of the basins like integrated management of the water resources, flood forecasting, water quality monitoring, adaptation to climate change etc.

2.3 The WHYCOS programme provide a better understanding of global hydrological cycle and improved knowledge on the status and trends of the world's fresh water resources. It supports research on climate change detection, impacts of climate change on water resources and assists countries in developing strategies in the water sector for adaptation to climate change. It also improves and strengthens cooperation between NHS's and NMS's and encourages regional cooperation.

2.4 It is known that water resources data and information is essential for national/basin/regional sustainable development, to contribute to a solution for the data issues, WHYCOS projects address its availability, accuracy, processing and dissemination. These data and information will be useful for various purposes including integrated water resources management, water resources assessment, flood forecasting and warning, groundwater monitoring and assessment, water quality monitoring, climate change research and adaptation to climate variability and change.

2.5 Mr Tawfik informed participants about the approach and procedures for developing a HYCOS component (project). When interested countries/regional institution/river basin organizations submit a request to WMO to assist them in developing a specific HYCOS component, WMO prepares a concept paper and circulates it to the requested party for comments and approval. Upon receipt of approval of the concept paper, WMO prepares a project proposal and circulates it to interested party for comments. A project proposal will be finalized after incorporating; WMO will assist the requested party to secure funds from potential donors for project implementation. This preparatory process for producing a project proposal could be accomplished in six months and will be financed by WMO.

2.6 Once the required funds are secured, project Implementation starts with a preparatory phase for one year. The main objective of the preparatory phase is to set up the institution structure and establish the implementation modality that includes preparation of detailed project document with detailed information about the selected stations, budget and workplan, identify a project regional centre, establish the project steering committee, recruitment of staff and obtain commitments from participating countries to cooperate in development and operating the project. The preparatory phase will be concluded by a steering committee meeting to endorse the detailed project document, workplan and budget.

2.7 The implementation phase starts immediately after the steering committee meeting and it will focus on field activities including the establishment of a network, regional data base, appropriate transmission system, training and production of useful hydrological information. The project could be operational in 3-4 years. After completion of the field activities, countries will be responsible for operating and maintaining the system with technical assistance from WMO.

2.8 Mr Tawfik noted that establishment of Hydrological Information System as an out put of HYCOS project will contribute to improving national and regional data collection systems and will strengthen national and regional data banks and support production and dissemination of useful products. In order to assist WHYCOS partners in developing and implementing the HYCOS components and also to ensure each project remains consistent with the WHYCOS objectives while responding to local needs, realities, and changing situations, WMO published WHYCOS Guidelines to provide guidance to partners on the main stages of project development, roles of different partners and how to govern, monitor and evaluate HYCOS projects. WMO developed WHYCOS web portal to establish links between different WHYCOS components, exchange experience among various projects and provide access to Web based data and information systems of HYCOS components.

2.9 He informed participants that the training programmes on the various HYCOS projects focus on nine modules addressing various technical issues. The training programme for each project is designed according to the training needs of the countries and is carried out on two levels, training of trainers (regional) and training of staff (national). Participants noted that the WHYCOS training programme is very useful to the region as it address the training needs in the region and identified specific modules to be considered in future training programmes.

2.10 Mr Tawfik concluded his presentation by presenting the current status of the various HYCOS projects in the different regions of WMO including the objectives, achievements and lessons learned from each project. Participants noted that the WHYCOS programme covers all WMO's regions and most of LDCs and small islands states are benefiting from the HYCOS projects. They also noted that HYCOS projects should be demand driven, data exchange policy should be clear from the project's beginning, and countries should be committed to cooperate, identify and agree whilst choosing appropriate technology suitable for the region.

2.11 A detailed presentation on the Pacific-HYCOS was made by Mr. John Fenwick from New Zealand, on behalf of SOPAC. He briefed the meeting about the background and status of implementation of various activities. He highlighted project achievements, lessons learned and the link with other HYCOS projects. The project's specific objective is to support a sustainable level of ability in participating countries to assess and monitor the status and trend of their water resources, while the overall objective is to develop capacity to assess the status and trend of national water resources and provide adequate warnings of water-related hazards.

2.12 The project is designed to address five priority areas as identified by RA V-WGH and it includes flood forecasting and warning, water resources assessment in major rivers, drought monitoring, groundwater monitoring and assessment, water quality monitoring and assessment and data management. It was originally conceived for 5 years, but the EU funding is only available for 3 years.

2.13 To support the capacity building component, regional training was conducted through regional Workshops and national training on various topics was organized (installation of equipment such as surface water stations and groundwater loggers, automatic rainfall gauges, as well as TIDEDA, GIS, loggers and software).



2.14 Mr Fenwick informed RA V-WGH that installation of equipment and implementation activities are almost completed. With finalisation of activities scheduled for late 2009 and early 2010 more than €700,000 worth of equipment has been purchased and deployed across 14 countries. More than €200,000 has been consumed for consultancies for specific installations and capacity building training. Communications strategy was developed to deliver “the right message to the right people in the right time” on water resource information.

2.15 He noted that unreliable transport for NHS effected both implementation and maintenance of surface and groundwater sites. Lack of commitment from governments to support data collection resulted in the deterioration of the network. Lack of awareness of the value of the information among various stakeholders led to poor quality of hydrological products. Retaining unnecessary staff and the absence of strong leadership or “champions” will weaken the project.

### **3. Country Presentations**

#### **Indonesia**

3.1 Dr Arie Setiadi Moerwanto, Director of the Research Center for Water Resources (RCWR) in Bandung presented Indonesia’s paper. He gave an overview of the current status of the hydrological services in Indonesia and the available facilities and products. He highlighted his country’s support to the development of SEA-HYCOS. He informed the meeting that there are fifty nine (59) River Basin Organizations (RBOs) in Indonesia, 31 RBOs are managed by the central government, 26 by local governments and 2 by the private sector. Participants noted that verification of the quality of data and its publication is the responsibility of RCWR.

3.2 Dr Moerwanto informed participants that most of the hydrological networks in Indonesia are equipped with manual and automatic stations; however some provinces have started to use telemetry stations. Currently most of RBO’s are working to upgrade and improve efficiency of their hydrological networks. New modern equipment has been installed while repairing and calibrating existing one.

3.3 The RBOs are responsible for Hydrological data collection and processing. The General Directorate of Water Resources (DGWR) provides guidance to the operational process while RCWR provides technical support to ensure standardization and consideration of Quality Management Framework (QMF). Meteorological and Climatological data collection and processing is the responsibility of Agency for Meteorology, Climate and Geophysics (BMKG). The RCWR supports data processing by issuing manuals for automatic and telemetry data management and calibrates hydrological and meteorological equipment according to ISO17025, and National QMF. Specialized universities and government owned companies have joined RCWR TECH 4 WATER initiative to develop telemetry equipment and Flood Forecasting and Warning System (FFWS).

3.4 Hydrological information is becoming very important as stakeholders in the water sector require useful information to raise public awareness. RCWR and BMKG produce such publications including river discharges, rainfall and climate outlook, and other information related to flood hazard which contribute to better integrated flood management. Information on water availability and water balance contribute to drought management while real time data will be used for flood early warning system.

3.5 Indonesia encourages neighbouring countries in the Southeast Asia region to actively participate in the development of SEA-HYCOS. The project will support capacity building, data

sharing, adaptive measures in the water sector to climate change. Indonesia will avail its facilities and expertise, including RCWR, to support the development of SEA-HYCOS and strengthen efforts for capacity development in the region. Dr Moerwanto requested WMO to assist RCWR in Quality Management Framework to ensure application of international standards in its calibration procedures.

## **Malaysia**

3.6 Ms Yusof Yuhaslin, Principal Assistant Director, Department of Irrigation and Drainage (DID) in Malaysia, made a presentation on the status of hydrological activities in Malaysia. She gave an overview of the responsibility and activities of various institutions dealing with water issues. She informed participants that there are many institutions working in the field of hydrology and water resources in Malaysia with different responsibilities including Malaysia Meteorology Department (MMD), Department of Irrigation and Drainage (DID), Department of Environment (DOE), Public Work Department (PWD), Water Boards, etc.. DID in accordance with ISO Standards, is responsible for operating and maintaining the hydrological network including data collection, storage, processing and dissemination of information. DID is authorized to charge users for supply of data except for the supply of data for government projects, researchers and academic purposes.

3.7 Ms Yuhaslin noted that RCWR offers a good opportunity to countries in the region to enhance their national capacity on water related issues. The available facilities and expertise within RCWR will improve the calibration and maintenance capabilities of NHSs in the region. She also supported Indonesia's initiative to develop SEA-HYCOS as it will address issues related to the water sector in Malaysia and expressed her country's support and cooperation with other interested countries to develop and implement SEA-HYCOS.

## **Philippines**

3.8 Ms Susan R. Espinueva, from the Weather and Flood Forecasting Centre in Philippines, made presentation on the status of the observation and telecommunication networks, data management systems and information requirements of the stakeholders in the water sector. She informed participants that the natural disasters by hydromet related hazards from 2004 to 2008 in the region, have underlined the crucial role of the PAGASA as the country's NMHS responsible for disaster risk management. PAGASA has national responsibility to produce Weather Forecasts, Tropical Cyclone warnings, Marine & shipping forecasts and Climate outlook. In collaboration with the NHSs, it also produces (MMDA) Flood bulletins & warnings for monitored major river basins/reservoirs and Flood situation for Metro Manila.

3.9 Through national and foreign funding (JICA, KOICA, AusAID, Norad and TECO), the Philippines has started its automation program through the improvement of its observation facilities and telecommunication networks. The enhancement program (2007-2012) will include the installation of 12 Doppler radars, more than a hundred automatic weather stations, wind profiler, and upper air stations, establishment of FFWS in several major river basins and reservoirs, upgrade telecommunication networks using available technologies and acquisition of fast computing systems for data processing and management. The Philippines has also signed a Memorandum of Understanding with the governments of Korea, Vietnam and Taiwan on data sharing and research activities including research institutes of the Government of Japan.

3.10 Ms Espinueva informed participants that recently, during the Manila floods this year, FFWS proved to be successful and effective. She also informed participants that in 2006 Philippines started using past flood approach to produce flood hazard maps which are working

with success. She gave an overview of two special initiatives for the promotion of community based flood early warning systems in small river basins and collaboration with private telecommunication companies on sharing of data and resources such as co-location of observation equipment in the sites of transmission towers. Ms Espinueva underlined the need for more effective high and low flow forecasts including adaptation to climate change impacts.

3.11 Ms Espinueva supported Malaysia views regarding the available facilities and expertise within RCWR which could be utilized effectively as potential Regional Centre to support capacity building initiatives in the region. She indicated that water resources and its availability are becoming a great concern to the countries in the region and water allocation represents a challenge to dam's operators. SEA-HYCOS project is relevant to countries needs and will assist them to address these important issues. It will improve water resources management, provide solutions to environmental degradation and lessen the impact of extreme events on water resources. She noted that the project will support the water sector in Philippines and complement the enhancement program (2007-2012). She expressed her country's support and cooperation with other interested countries to develop and implement SEA-HYCOS.

#### **4. Conclusion and Recommendations**

4.1 Participants noted with satisfaction WMO's approach to support and strengthen the capacity of National Meteorological and Hydrological Services (NMHSs) of its members to address water issues and allow them to actively participate in their country development plans.

4.2 Participants also noted the success achieved in implementing different HYCOS projects in different regions and the progress in implementing the Pacific-HYCOS. They agreed that there is a need to develop a HYCOS component for the South East Asia countries. Indonesia, Malaysia and Philippines agreed to cooperate and collaborate in developing the SEA-HYCOS.

4.3 Considering interest expressed by three countries (Indonesia, Malaysia and Philippines), participants requested WMO to support their initiative to develop the SEA-HYCOS and agreed to include the development of SEA-HYCOS in their future work plan (2010 -2013) for RA V-WGH.

4.4 In accordance with WHYCOS Guidelines, Indonesia, Malaysia and Philippines agreed to follow WMO's procedures to develop the SEA-HYCOS. In this regard, the three countries agreed to submit as soon as possible an official request to WMO to assist them in developing the SEA-HYCOS. It is recommended to invite other countries in the region to join the initiative including Brunei Darussalam and Singapore.

4.5 SEA HYCOS project should include several components to achieve its objectives of supporting sustainable development in participating countries. Eight components were identified including efficient use and management of water resources, impact of extreme hydrological hazards on groundwater, flood forecasting and early warning, drought monitoring, information sharing and cooperation with dams managers, capacity building and hazard mapping and GIS.

4.6 Participants noted the need to strengthen regional cooperation, exchange data and experience and address the Climate Change impact on the water sector to develop effective and realistic adaptation strategies. It is agreed that SEA-HYCOS will contribute to address this issue.

4.7 Recognizing the excellent facilities and expertise available in RCWR, participants requested WMO to consider recognizing RCWR as WMO Regional Training Centre on Hydrology (WMO RTC – Hydrology). The process of establishing new Centres includes endorsement by the regional association, the technical commission concerned and by the WMO

Secretariat; approval by the Executive Council; and the signing of an Agreement between the host country and WMO. It was agreed that WMO will provide RCWR with the Guidelines on the practical application of the EC criteria for the recognition of WMO regional training centers to ensure submission of the request in accordance with official procedures.

## **B. 1 THE 7<sup>th</sup> SESSION OF RA V WORKING GROUP ON HYDROLOGY**

### **3 CONSIDERATION OF RELEVANT DECISIONS OF Cg-XV, XIV-RA V, CHy-XIII AND EXECUTIVE COUNCIL SESSIONS**

The WMO Secretariat informed the meeting of major decisions taken by Cg-XV, XIV-RA V, CHy-XIII, EC-LIV, EC-LV, EC-LVI and EC-LVII, which were relevant to regional aspects of hydrology and water resources programmes.

#### **3.1 THE FOURTEENTH SESSION OF THE REGIONAL ASSOCIATION V**

3.1.1 The meeting noted that the fourteenth session of the Regional Association V (South-West Pacific) was held in Adelaide, Australia, from 9 to 16 May 2006 where resolution 14 (XIV-RA V) was adopted re-establishing the Working Group on Hydrology which was open to all Members of the Region, with a core membership composed of a chairperson and seven expert members.

3.1.2 The needs for capacity building in the Region, especially in the area of Integrated Water Resources Management was recognized as priority in the region. RA V members commended the efforts of WMO, SOPAC and member countries in implementing specific training courses on hydrology.

#### **3.2 THE FIFTEENTH WORLD METEOROLOGICAL CONGRESS (CG-XV)**

3.2.1 The WGH members also noted that the fifteenth World Meteorological Congress (Cg-XV) met in Geneva in May 2007. The Congress recognized that Regional Working Group on Hydrology formed one of the strong mechanisms to liaise with regional hydrological communities and interpret their needs and requirements; it also recognized the declining level of support to their activities and the need to strengthen this support.

3.2.2 WGH members noted that Congress recognized that the water sector in a broad sense represents a major area in WMO's contribution to the Millennium Development Goals (MDG) as many of them are closely related to water themes; Congress appreciated the efforts made to raise extra-budgetary funds for the implementation of various WHYCOS components and invited Member and regional institutions to collaborate with the Secretariat to secure funds required for the implementation of HYCOS proposal still awaiting support.

3.2.3 WGH members also noted that Congress appreciated the general approach of the Strategy on Education and Training in Hydrology and Water Resources that, without forgetting the core business of National Hydrological Services (courses on maintenance of automatic stations, rating curves, hydrometry and topography), tried to encompass more general topics (management techniques described in the Guidelines on the Role, Operation and Management of National Hydrological Services, courses on Integrated Flood Management, Integrated Water Resources Management and Water Affairs) to respond to the new responsibilities assigned to NMHSs in recent times by their governments.

3.2.4 WGH members appreciated Congress's support to the proposed principle, subsequently adopted by the Commission that Quality Management Framework (QMF) should concentrate on the activities of NHSs and therefore, in addition to the improvement of the administrative and managerial aspects included in a quality management system, emphasis should also be put on the development of standards and recommended practices. They also noted that Congress encouraged Members who had completed the implementation of a Quality Management Systems (QMS) to provide support to other Members in the form of hosting lectures, training seminars, visits, etc. to better understand how successful QMS were implemented.

3.2.5 WGH members were pleased to know that WMO and the International Organization for Standardization (ISO) in September 2008 entered a working arrangement aimed to strengthen the development of International Standards and to avoid duplication of work on standards related to meteorological, climatological, hydrological, marine and related environmental data, products and services. WMO and ISO will develop, approve and publish common standards based on WMO technical regulations, manuals and guides and relevant WMO documents will be adopted by ISO as ISO standards.

### **3.3 SESSIONS OF THE EXECUTIVE COUNCIL**

3.3.1 WGH members also noted that EC LVIII, held in Geneva in June 2006 discussed a number of issues of direct relevance to CHy. In particular the Council expressed support for the proposal to have WMO Regional Training Centres (RTCs) in a range of disciplines in lieu of more narrow-scope WMO Regional Meteorological Training Centres. The Council also included representatives from the Commission for Hydrology on a number of key planning groups of the EC which were to provide significant input to Congress, including the Strategic Plan and budgets.

3.3.2 WGH members noted that in 2008 EC LX was the first in which the organization of the discussion was geared to WMO's Expected Results according to the Strategic Plan and Result Bases Budgeting principles. At EC-LX the matters of relevance to CHy raised included the need to describe and promote the Future Work Programme for CHy under the Expected Results framework; need to develop a possible mechanism for greater involvement of developing countries in the work programmes of the Commissions; actions that will improve coordination and cooperation between WMO and UNESCO in hydrology and water resources; and role and mandate of the technical commissions.

3.3.3 WGH members also noted that Council urged Members to support the hydrological data rescue activity, including experimental data, which were fundamental for trend analysis and understanding the effects of climate change.

3.3.4 They noted that in 2009 EC LXI, in response to Recommendation (1) of the CHy-XIII, requested the presidents of technical commissions to review the concept of mandatory publications in the light of the WMO's Quality Management Framework and recent technological advances in publications and bring to the Executive Council at its sixty-second session a proposed set of criteria for defining a consolidated, revised set of mandatory publications for its endorsement by Sixteenth Congress. Regarding CHy-XIII Recommendation (2), the Executive Council requested the Inter-Commission Task Team on Quality Management Framework to consider the development of a glossary on terminology related to the Quality Management Framework, including the use of the term "standard".

3.3.5 WGH members noted with satisfaction the Council's request to the Secretary-General to consider the development of new HYCOS components in South East Asia (SEA-HYCOS) in order to address the need of the transboundary basins in the region. They appreciated WMO's response

and the organization of a planning meeting for development of SEA-HYCOS during the 7<sup>th</sup> RA V WGH session.

3.3.6 WGH members shared the same concern as the Council regarding the implications to streamline Regional Associations structure in accordance with the Results-Based Management (RBM) principles and the recent trend of discontinuing some of the Regional Working Groups in Hydrology, or blending them into Climate and Water Working Groups, may have adverse impacts on the traditional/basic activities of the NHSs in the field of operational hydrology. Therefore, they urged RA V to be inclusive and consider all the hydrology/water related needs in the region (citing as an example those related to operational hydrological forecasting and warning), while expressing their needs and priorities and not restrict them to the emerging needs related to impacts of climate change and variability on water resources.

### **3.4 THIRTEENTH SESSION OF THE COMMISSION FOR HYDROLOGY**

3.4.1 The WGH members noted that the Thirteenth session of the Commission for Hydrology was held in Geneva from 4 to 12 November 2008. To enable the participation of experts without physically joining the session, important documents to be discussed at the session were posted in an internet forum for electronic discussions through a pre-session. The Executive council appreciated this initiative and recommended that other Commissions follow CHy approach.

3.4.2 WGH members noted that the Commission adopted four thematic areas as priority for its work in the next intersessional period, and developed corresponding sets of activities and expected outputs and outcomes for each theme area. The four thematic areas include Quality Management Framework–Hydrology (QMF–Hydrology), Water Resources Assessment, Hydrological Forecasting and Prediction and Water, Climate and Risk Management

3.4.3 WGH members noted that the Commission unanimously re-elected Mr Bruce Stewart (RA V-Australia) president and Mr Julius Wellens-Mensah (RA I-Ghana) vice-president for the next intersessional period. The Commission also nominated an Advisory Working Group (AWG) composed of seven members from different regions, each responsible to implement activities related to the thematic areas and WMO Integrated Global Observing system (WIGOS) and WMO Information System (WIS). The Commission re-established the existing OPACHEs and urged Members to nominate additional experts to OPACHEs and to facilitate voluntary contribution of all members of the OPACHEs to the activities of the Commission.

### **3.5 ADOPTION OF QUALITY MANAGEMENT FRAMEWORK FOR HYDROLOGY**

3.5.1 WGH members noted that the Quality Management Framework – Hydrology with the goal of providing an overall strategy, advice and guidance tools for NHS to attain efficiency, quality and effectiveness in their functioning was adopted by CHy. The QMF-Hydrology is an integral part of the overall WMO QMF. It includes documentation on approaches to QMS and guidance on its adoption and implementation, documentation and guidance on management of NHSs, documentation on technical approaches for the provision of hydrological data, products and services and development of training modules and materials.

3.5.2 With the adoption of a QMF-Hydrology, the publications brought out under the technical guidance of the Commission should undergo a comprehensive peer review before they were recommended for adoption as tools for the QMS. Therefore, the Commission adopted an updated peer review process for these publications which has been further detailed by AWG at its first meeting in February 2009.

3.5.3 The “WMO statement on the scientific basis for, and limitations of, river discharge and stage forecasting”, was placed on the e-board and opened for e-discussions through the Forum. Members of CHy and other experts were informed through e-mails of the e-discussions and were invited to provide comments and inputs.

### **3.6 INFOHYDRO**

3.6.1 WGH members noted that responding to the need to improve the level of information on the status of the hydrological networks, CHy had developed a simplified Hydrological Information Referral Service (INFOHYDRO) questionnaire for a survey of national agencies dealing with hydrological measurements, their activities, networks and related metadata. After a test run conducted in English, the INFOHYDRO questionnaire had been translated into French, Russian and Spanish and circulated to all Members in July 2007 at present only 34 countries (out of which only 1 from Region V) have provided information to the INFOHYDRO data bank. CHy XIII urged Members to make special efforts to complete the information required in the INFOHYDRO.

### **3.7 CAPACITY BUILDING**

3.7.1 The CHy revised the WMO Strategy on Education and Training in Hydrology and Water Resources, and decided that it should guide the activities of the Organization in this area for the period 2009-2012. The strategy was developed to i) assist Members in assessing their own education and training need in Hydrology and Water Resources, ii) provide adequate education and training to personnel of NHSs, iii) assist Members in developing or updating national curricula in Hydrology and Water Resources and iv) optimize the use of available resources and mobilize extra budgetary resources. The strategy addresses as primary target group technical and professional staff of NHSs, with special focus on the NHSs of developing countries, and as a secondary group academia and other governmental agencies. Education and training activities supported by WMO should be in principle demand-driven and based on the inputs from Members, Regional Working Group on Hydrology and surveys. Emphasis will be placed on short-duration, low-cost and high-impact activities such as training of trainers and roving seminars. Particular attention will be also given to distance and blended learning and to the promotion of the *Guidelines for the Education and Training of Personnel in meteorology and Operational Hydrology* (WMO No. 258) Vol. II – Hydrology.

### **3.8 HOMS**

3.8.1 WGH members noted that CHy recognized HOMS mission and objectives, as presented in the HOMS plan for the XXI century are still valid and relevant. CHy expressed concern on the lack of updating of the existing components and the minimal contribution of new ones during the last decade. This was a result of the reduction of staff dedicated to international cooperation activities in the NHSs which were traditionally major suppliers of HOMS components and by the advent of Internet which has made easier both the dissemination and the search of pieces of technology.

3.8.2 It was noted that CHy wished to retain the positive aspects of HOMS reflected in the reputation of reliability of HOMS components derived from their proven operational value, and the network of national and regional HOMS focal points. Alternative Approaches were developed for the future of HOMS proposing to change the name in order to reflect the programme’s main purpose of Technology Transfer in Hydrology and Water Resources, to maintain and possibly further develop the present on line version and to create a repository of components no longer supported by the providers in order to ensure that they are not completely lost.

### **3.9 CLIMATE AND WATER ISSUES**

3.9.1 WGH members noted that CHy decided to actively participate in the development of the WMO Initiative to encourage provision and dissemination of climate and hydrological information in support of hydrology and climate research, adaptation to climate change and climate variability and in providing feedback from the water community. WMO Members were requested to provide tools, mechanisms technologies and know-how related to hydrological impacts of climate change and variability, including extreme events, and share them among all members through HOMS

### **3.10 DATA EXCHANGE AND HYDROLOGICAL INFORMATION SYSTEMS**

3.10.1 WGH members noted that NHS's capability to store, manage and retrieve data on various hydro-ecological variables originated by a range of different instruments and probes, is becoming a critical element of their functions in support of their capabilities to generate analysis and other information products. With a view to provide to the Members' NHS guidance for the assessment of their requirements and the design or purchase of the most suitable system for their needs, WMO, In cooperation with the Water Survey of Canada (WSC), is in the process of preparing a document on "Hydrological Information System (HIS) Requirements and Inter-Comparison of Commercially Available Systems".

3.10.2 The document discusses the processes and functionalities that must be available in an HIS starting with the high level approach of a generic HIS system and providing details on processes and tasks related to data acquisition, validation and production. It further provides a proposed procedure to evaluate HIS based on the Canadian approach, including a step-by-step method to define system functionalities, evaluate and acquire an HIS. The document also contains the results of an inter-comparison carried out in 2009 of 26 commercially available Hydrological Information Systems

## **4. OTHER PROJECTS AND ACTIVITIES RELEVANT TO HWRP IMPLEMENTATION**

### **4.1 ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT EQUIPMENT**

4.1.1 WMO representative informed participants that the thirteenth session of CHy approved the rationale and the work plan for the project. The project would encourage and solicit testing by contributing NHSs of the newer instrumentation and methodologies. Expected outcomes include summary of the field discharge measurement instrumentation and techniques, collection of international and national standards and guidelines, a framework for the assessment of uncertainties in discharge measurement, guidelines for conducting and reporting results of instrument calibration, collection of test reports, and the creation of a website to disseminate the results, available on line since august 2008 (<http://www.wmo.int/pages/prog/hwrp/FlowMeasurement.html>).

### **4.2 HYDROLOGICAL FORECASTING**

4.2.1 In 2003, WMO started the implementation of the Flood Forecasting Initiative (FFI) with the goal to improve the capacity of meteorological and hydrological services to jointly deliver timely and more accurate products and services required in flood forecasting and warning and in collaborating with disaster managers, active in flood emergency preparedness and response.

4.2.2 A number of regional workshops have been organized bringing together forecasters from HNHs and NMSs as well as representatives of regional and technical institutions to discuss the



present status, shortcomings and perspectives of flood forecasting in the various WMO regions. The WMO Regional Expert Meeting on Improved Meteorological and Hydrological Forecasting in RA V was included in the programme of RA V-WGH meetings in 2005 and 2007 and a special workshop for RA II was organized in Bangkok (Thailand) in December 2005.

4.2.3 Based on the conclusions and recommendations of the regional workshops, a global Synthesis Conference was held in 2006 at the WMO headquarters in Geneva. Experts at the Conference agreed on a "Strategy and action plan for the enhancement of cooperation between national meteorological and hydrological services for improved flood forecasting". The CHy is preparing a detailed activity plan to supplement the Strategy and Action Plan on the FFI and to assist Members establish flood forecasting systems.

4.2.4 WGH members noted that as a follow-up to Resolution 21 (Cg-XV) – Strategy for the Enhancement of Cooperation between National Meteorological and National Hydrological Services for improved flood forecasting a Flash Flood Guidance System (FFGS) is being developed with plans to implement regional components. The system is being developed and implemented in cooperation with the USA National Oceanic and Atmospheric Administration (NOAA) and the Hydrologic Research Centre in San Diego.

### **4.3 ASSOCIATE PROGRAMME ON FLOOD MANAGEMENT**

4.3.1 An Integrated Flood Management Open Network Conference & Training of Trainers was held in Jakarta, Indonesia from 24 to 28 in February 2009 with the support of Cap-Net, World Bank, NUFFIC, CKNet-INA and AguaJaring as part of a of a collaborative capacity building programme "Integrated Flood Management for Sustainable Development" with the aim of introducing to participant an IFM concept and tools and exchange of experiences and approaches. This event has been followed by two national workshops in Indonesia (Bandung, 15-18 June 2009) and in Malaysia (Kuala Lumpur, 10-14 August 2009).

4.3.2 CHy approved the establishment of a HelpDesk for Integrated Flood Management. It was set up and launched on 17 June 2009 during the Global Platform for Disaster Risk Reduction. The WGH members noted that the HelpDesk is not a mechanism for responding to flood emergencies but intends to provide advice to Members in the areas of flood management policy and strategy, and capacity building. It is supported by the professional capacity of its multidisciplinary partners, including highly specialized centers of excellence, development partners, national governments and international organizations, to provide a demand-driven mechanism for addressing flood management realities. Since the inception of the HelpDesk in June 2009, a number of training or information events have been organized in Mauritania, Italy and for the Nile basin countries.

### **4.4 WHYCOS AND OTHER COOPERATION PROJECTS**

4.4.1 The WGH members noted that Six HYCOS projects are under implementation in RA I, RA II, RA IV and RA V (Niger-HYCOS, Volta-HYCOS, SADC-HYCOS, Mekong-HYCOS, Pacific-HYCOS and Carib-HYCOS) involving 52 Member countries, out of which more than 30 are Least Development Countries (LDCs) and 21 Small Island Developing States (SIDS) with financial support from France, the Netherlands and the European Commission.

4.4.2 WGH members noted with satisfaction progress made on the implementation of the Pacific-HYCOS and the substantial advances in the implementation of the project activities. Recognizing that the long term sustainability of data collection and information production depends on the generation of value added information as required by users demand, the project has also

embarked on the development of a communication strategy. A site presenting project documents, activities and reports has also been realized established (<http://www.pacific-hycos.org>)

4.4.3 WGH members noted that, during last meeting of the WHYCOS International Advisory Group (WIAG), experts recommended, that WMO should make all training modules and relevant materials which have been prepared for projects under implementation be available for utilization by other projects and NHSs.

#### **4.5 COOPERATION WITH IGOs, NGOs AND OTHER UN ORGANIZATIONS**

4.5.1 The WGH members noted that WMO participated in the 5th World Water Forum (Istanbul, Turkey, from 16 to 23 March 2009). Two technical sessions on "Managing Water-related Risks in a Changing Climate" and "Data for All" were co-organized by WMO in collaboration with UNESCO, IAH. In an effort to raise the visibility of WMO and its Members, several stands in the World Water Expo and the UN Water Pavilion were used to disseminate various WMO and related materials in collaboration with the Turkish State Meteorological Service.

4.5.2 The World Climate Conference-3 (WCC-3) was organized by WMO, in Geneva, Switzerland from 31 August 2008 to 4 September 2009 (<http://www.wmo.int/wcc3/>). The Conference was organized in two segments, expert segment (attended by more than 1500 participants) and a high level segment attended by 13 head of states and 86 ministers. It was agreed to establish a Global Framework for Climate Services to Enable better management of the risks of climate variability and change and adaptation to climate change at all levels, through development and incorporation of science-based climate information and prediction into planning, policy and practice. A task force of high-level, independent advisors will be appointed by the WMO Secretary-General on the basis of terms of reference agreed by the member states and will prepare, in consultation with governments, partner organizations and relevant stakeholders, a report including recommendations on proposed elements of the Framework, to be submitted to the Secretary-General of WMO and subsequently considered at the next WMO Congress in 2011.

4.5.3 WGH members noted that , with the aim of bridging the knowledge and communication gap between climatologists and water managers and facilitating the transfer of know-how and technology and promoting research and development through partnerships and capacity building (in particular in developing countries), WMO is supporting national efforts to implement projects on adaptation to climate change in the water sector, with the goals to: (i) create national enabling environments to facilitate the use of climate information in water resources planning, operation of water infrastructures, disaster management; (ii) carry out scientific assessments of the climate change impacts on water resources and build awareness,(iii) assess significant impacts on existing or proposed water system operation rules, system design and sizing, policies and water use strategies, (iv) develop knowledge through research and development on water management issues related to climate predictions, variability and change, and (v) contribute to the activities in the countries by developing adaptation strategies for the planning and operation of water resources infrastructure and disaster management. Two pilot projects, in Mexico and Egypt, are presently underway.

4.5.4 Within the framework of the restructuring of the Secretariat, aimed at streamlining its activities and aligning them with the expected results of the Strategic Plan, the former departments Hydrology and Water Resources and World Climate Programme, have been merged into a new department Climate and Water.

## **5. REPORT OF CHAIRMAN OF WORKING GROUP**

5.1 Mr. John Fenwick of New Zealand, on behalf of the Chairman of the Working Group, Mr Charles Person, presented the Chairman's Report on the work of the group during the intersessional period (2006 – 2010). In his report the Chairman, provided an overview of activities that have been undertaken during the period and outlined some of the challenges related to hydrological issues in the region. He also indicated results of his communication with RA V-WGH members to address issues related to Pacific-HYCOS, SEA-HYCOS and to collect input from hydrological community in RA V to the workplan of the WMO Commission for Hydrology (CHy).

5.2 A joint Flood Forecasting Workshop, Pacific HYCOS Project Launch and RA V -Working Group on Hydrology Meeting was held in Brisbane, Australia from 16-19 April 2007. The meeting was organised in collaboration with Bureau of Meteorology (BOM) Australia, World Meteorological Organisation (WMO), National Institute for Water and Atmosphere Research (NIWA), and Pacific Islands Applied Geoscience Commission (SOPAC). The meeting and workshop were funded by WMO, BOM and SOPAC.

5.3 The first day was devoted to a workshop on Flood Forecasting Workshop to present and discuss the outcome of the Synthesis Conference of the WMO Flood Forecasting Initiative and the draft Strategy. The second and third day were allocated to the 1<sup>st</sup> Steering Committee meeting for the Pacific-HYCOS to officially launch the Pacific HYCOS Project, discuss, identify and agree on issues related to implementation procedures including workplan and establishment of a Project Steering committee (PSC). The fourth day of the meeting was devoted to RA V-WGH session to discuss the workplan and agree on specific activities. The meeting also discussed issues related to Groundwater in the region.

5.4 The Pacific-HYCOS project has been executed by SOPAC with WMO as technical supervising agency. To date it has managed to achieve some of its objectives despite the limited infrastructure support to National Hydrological Services (NHSs) in the participating countries. He expressed concern about the countries ability to sustain operations and to maintain the surface and ground water monitoring network. He indicated that the project has been considered as an important cornerstone on which other projects have been initiated, such as flood forecasting ventures. He underlined the need for developing SEA – HYCOS and recommended to be linked to other HYCOS projects to avoid future implementation obstacles.

5.5 Following Brisbane meeting in April 2007, and the WMO Congress in Geneva in May 2007, the Chairman communicated with RA V-WGH members by e-mail on 5<sup>th</sup> November 2007 inviting them to provide input into WMO's Commission for Hydrology long-term planning, for the next four years and beyond. He circulated a document prepared by CHy President Mr Bruce Stewart to collect their views and contribution as input from Pacific Island Countries (PICs) for consideration in the CHy activities.

5.6 The message was circulated to all members of RA V-WGH to provide comments and views on specific issues including HYCOS projects, hydrological Networks, Training on hydrological, hydrological Instruments/ equipment, hydrological Forecasting, water resources assessment, communications, WMO regional role/presence, regional initiatives and NHS funding needs. Seven responses were received from six PICs, two from SOPAC and one from the previous Chairman. The responses reflected clearly the PICs needs and priorities. It was analyzed, summarized and submitted to the CHy President for consideration when developing and planning CHy work plan and related activities.

5.7 He underlined the major challenges including maintenance and operating hydrological networks, training, instruments and equipment, flood forecasting and drought prediction, water resources assessment, communications with other service providers, users and decision makers, the regional presence of WMO, and the funding of NHSs. He suggested that participants use the opportunity of following up the outcome of Copenhagen climate change global conference to highlight the hydrological challenges to RA V presented by climate change, the need to strengthen NHSs financially and technically in order to be able to provide the monitoring and services that will be required.

5.8 The Chairman of the Working Group, in his report, reminded participants about the role of RA V-WGH and how its members can play a key role to resolve many challenges. In this regard, he requested participants to focus their discussions during the meeting on the challenges facing RAV-WGH and NHSs in PICs and to agree on an appropriate approach to address these challenges.

## **6. CONSIDERATION OF WORK OF RA V – WGH**

6.1 Participants noted the chairman's report and appreciated his support for the implementation of the work programme of RA V-WGH. They appreciated cooperation and collaboration amongst BOM, SOPAC, NIWA and WMO to ensure successful organization of the 2007 Brisbane meeting. They also appreciated the financial support provided by WMO and SOPAC to representatives of NMHSs from PICs to enable them to participate in the meeting.

6.2 Participants noted with satisfaction progress achieved in implementing the Pacific-HYCOS activities. They also noted with regret the absence of SOPAC representative and felt that this deprived them the opportunity to have in depth discussions about future plans when the EU fund will be fully consumed. They requested WMO to continue collaboration with SOPAC to develop phase II with the aim of completing the remaining activities from phase I in order to achieve the objectives.

6.3 WGH members noted that some activities included in the 2005-2009 workplan are yet to be completed and should be considered in the 2010-2014 workplan. In order to have a comprehensive report about the status of the water sector in the region, members from Cook Islands, Fiji, New Zealand, Samoa, Solomon Islands and Vanuatu made presentations on the institutional and technical arrangements in the water sector of their countries.

### **6.4 COUNTRY PRESENTATIONS**

#### **Cook Islands**

6.4.1 Mr Adrian Teotahi from Cook Islands made a presentation on the institutional and technical capacity of the water sector in his country. He informed WGH members that his country lacks trained personnel in hydrology and water resources. They received from SOPAC hydrological equipment for Pacific-HYCOS and they need training in instrumentation to be able to maintain the stations. He identified capacity building as a priority activity for his country and recommended to utilize available facilities in the region such as RCWR in Indonesia for training activities. Mr Teotahi informed WGH members that Groundwater and Flash Floods are of great concern in his country.

## **Fiji**

6.4.2 Mr Seremaia Koroi from Fiji informed WGH members that his country has a severe shortage of qualified staff, it only has three hydrologists who need to be re-enforced with more new recruits. The NHSs and NMSs are working independently as they do not belong to the same Ministry. The Government of Fiji is planning to privatize NHSs. The NHS staff are trying to convince the government to change the privatization plan and to replace it with one integrating NHS and NMS under one institution. He updated the group with the latest information about development of Pacific-HYCOS activities in PICs. He identified vandalism as a major issue which requires quick attention.

## **New Zealand**

6.4.3 Mr John Fenwick from New Zealand made a presentation on the National Institute of Water & Atmospheric Research (NIWA) which operates as the National Hydrological Service of New Zealand. He informed WGH that a number of regional government agencies have responsibility for water resource allocation and they have special networks for this purpose.

6.4.4 NIWA maintains and operates the National Water Resources Database (NWRD). In addition to NWRD, NIWA also operates national databases of Climate data and Water Quality data. The Climate Database is now on-line and data are free. It covers data from many meteorological, climate and rainfall stations around New Zealand and the Pacific Islands, back to the 1870s. Similarly, the hydrological data collected using public funds are available at <http://edenz.niwa.co.nz/>. The NWRD include data from 2100 stations belonging to NIWA and other agencies.

6.4.5 NIWA collects and process hydrological data from telemetry or automatic stations, on a three-month cycle. A quality assurance programme is operated, with ISO registration 9001. Specific data are also collected for other entities, notably the hydro-power companies. Telemetry and data loggers are widely used (>300 stations) and communications paths include cell phone GPRS, CDMA and 3G, VHF and UHF radio, and satellite systems. The instrument service centre tries to standardise all equipment as much as possible, to limit the need to train staff on a wide range of technology.

## **Samoa**

6.4.6 Mr Lameko Asora from Samoa recalled the 1st Annual Joint Water Sector Review in 28/10/2008 where it was indicated that the capacity of the water sector in 2008/2009 should be built for "improved and coordinated data and information management (data and information collection, analysis, storage and dissemination)" in this regard his presentation focused on an overview of Water Resources Division, data management and use of hydrological data for WR Management.

6.4.7 The hydrological monitoring in Samoa goes back to 1890s for the rainfall network while river flows and groundwater goes back to 1970s. The current hydrological network consist of 11 rain gauges, 14 flow gauges, 17 WQ sites and a future plan to include additional 8 rain gauges, 3 flow gauges, 20 boreholes in 2 years. There are problems affecting the quality of this data such as the gaps in records, exact historical location and verification.

6.4.8 He informed WGH members that his country receives training assistance from the governments of China and Australia in the field of hydrology. He identified training in the form of

short courses on various topics related to hydrology as priority. He expressed satisfaction with the progress in implementing Pacific-HYCOS activities in Samoa. He requested WMO to consider organizing frequent meetings for WGH members to allow more communication and exchange of experience and information.

## **Solomon Islands**

6.4.9 Mr Michael Maehaka, from Solomon Islands, stressed the need for exchanging information and underlined the impact of absence of quality information. He noted that there is no reliable Hydrological information System (HIS) existing in his country. He identified monitoring network as priority area for his country and called for more cooperation among WGH members to exchange experience in operating and maintaining hydrological network.

## **Vanuatu**

6.4.10 Mr Christopher Loan from Vanuatu made a presentation on the institutional and technical arrangements in Vanuatu related to water resources with a focus on Pacific-HYCOS activities, challenges and the way forward. He informed WGH members that the Department of Geology, Mineral and Water Resources (DGMWR) in the Ministry of Land and Natural Resources (MLNR) is responsible for the water sector including operational hydrology in the country. He indicated that Pacific-HYCOS was developed to improve water quality & quantity monitoring system in order to understand the impact of development (forestry, mining...) on river catchments and aquifers and to support hydropower development and flood warning. He briefed WGH members on the achievements including establishment of automatic rainfall and water level stations and the installation of a data management system. The lack of technical staff, high cost of mobilization due to geographical locations of islands and vandalism were major challenges to sustainability of the project.

6.4.11 Mr Christopher Loan indicated that cooperation between various stakeholders should be encouraged to avoid duplication and governments should be committed to provide the necessary support to ensure sustainability. He underlined the vital role of WMO's sub-regional office in supporting NMHSs in the region and stressed the need to include an expert in hydrology in the office to support the hydrological community in PICs. He informed WGH members about his country's concern about the water quality in Vanuatu and identified water quality monitoring as a priority area. He agreed with other areas identified by other members especially those related to training.

## **7. DISCUSSION ON THE IMPLEMENTATION OF THE HYDROLOGY AND WATER RESOURCES PROGRAMME IN RELATION TO THE NEEDS OF THE REGION**

### **7.1 RA V STRATEGIC PLAN**

7.1.1 Mr Henry Taiki, Regional Programme officer, WMO sub-regional office, made a presentation on WMO Strategic Plan (SP) with a focus on Regional Strategic Planning and the new approach to XV-RA V and future RA V Working Mechanism. WGH members noted that the three top-level long-term objectives of WMO are to improve forecasts, provide more accurate, timely and reliable forecasts and warnings and enhance delivery of information and services. This will allow WMO to continue its critical international role as an authoritative scientific voice and to provide Scientific and Technical expertise and advice in support of policy-making.

7.1.2 WGH members noted that SP is composed of three (3) Top-level Objectives to address five (5) Strategic Thrusts (ST) with eleven (11) Expected Results (ERs) to be achieved through Deliverables (activities). Mr Taiki informed WGH members about the status of the development of the draft RA V Strategic Plan. While acknowledging the works which have already been put into developing the Plan, the meeting requested that the regional expected results could be improved by taking into consideration the identified regional priority needs in hydrology and water resources and Work Plan (2010-2013) for the Working Group on Hydrology.

## **7.2 BRAIN-STORMING EXERCISE TO IDENTIFY NEEDS OF THE REGION AND PROPOSED RECOMMENDATIONS**

7.2.1 WGH members agreed to have a brainstorming session to identify and discuss the needs of Region V in hydrology and water resources. The brainstorming session was chaired by Dr Arie Setiadi Moerwanto (Indonesia) with secretarial support from WMO.

## **7.3 IDENTIFIED REGIONAL PRIORITY NEEDS**

7.3.1 WGH members identified eight issues as regional priority needs for hydrology and water resources: (1) Education, training and capacity building; (2) HYCOS projects; (3) Adaptation to climate change in water sector; (4) Water quality monitoring and assessment; (5) Sustainable maintenance and calibration of equipment for hydrology and water resources; (6) Flood forecasting; (7) Exchanging and sharing of hydrological data and information and (8) Quality management Framework (QMF).

## **7.4 RECOMMENDATIONS**

7.4.1 To address the regional priority needs for hydrology and water resources, RA V, RA V-WGH members suggested some actions to be considered in developing their work plan (2010-2013) as summarized below.

### **(I) Education, Training and Capacity Building**

- Strengthening institutional arrangement and capacity of NHSs including coordination with NMSs and provide training for NHSs' managers.
- WMO to assist countries obtain fellowships for both long-term and short-term training in hydrology and water resources.
- Request WMO to process the designation of Indonesia Research Center for Water Resources (RCWR) as WMO Regional Training Center (RTC) on Hydrology.
- Raising profile of NHSs and HWRS through:
  - Collaboration with NGOs on public awareness
  - Consider training and responsibility of implementing HWR activities to include provincial level

### **(II) HYCOS projects**

- Development of a SEA HYCOS project
- Strengthening the Pacific HYCOS.

### **(III) Adaptation to Climate Change in Water Sector**

- Support research in hydrology and water resources in relation to climate change.
- Strengthen national capacity for development appropriate adaptation measures

### **(IV) Water Quality Monitoring and Assessment**

- Include water quality component in SEA-HYCOS.
- Strengthen water quality monitoring and assessment component in Pacific-HYCOS.

### **(V) Maintenance and Calibration of Equipment for Hydrology**

- Identify suitable equipment and technologies applicable to the region.
- Encourage and support maintenance and calibration of hydrology and water resources equipment.
- Promote regional standardization in purchasing equipment for hydrology and water resources and encourage regional products.
- Utilize available facility in the region for capacity building and support the designation of Indonesia Research Center for Water Resources (RCWR) as a WMO Regional Center (WMO-RC on Hydrology) for hydrology and water resources.

### **(VI) Flood Forecasting**

- Improve Flood Early Warning Systems (FEWS)
- Consider Flash Floods issue and promote the development of Flash Flood Guidance System (FFGS) in the region.
- Introduce and promote Integrated Flood Management (IFM) concept
- Raising awareness about social and economic benefits and value of flood forecasting systems.
- Consider Drought predication.

### **(VII) Exchange of Hydrological Data and Information**

- Strengthen communication links among experts in the region to encourage exchange of experiences, information and technology in hydrology and water resources among Members of Region V.
- Promote implementation of WMO Resolutions 25 and 40 related to data exchange.

### **(VIII) Quality management Framework (QMF)**

- Adoption of ISO standards including interpretation of ISO standards for HWR in Region V
- Promote development and implementation of national quality management system.
- Participate in WMO QMF activities.



## **8 FUTURE ACTIVITIES OF RA V IN THE FIELD OF HYDROLOGY AND RESOURCES**

### **8.1 FUTURE WORK PLAN (2010-2013)**

8.1.1 The meeting was informed that the fifteenth session of WMO Regional Association V would be held in Bali, Indonesia, from 30 April to 6 May 2010. It is therefore agreed that the draft report of the seventh session of RA V WGH be finalized by the end of January 2010 and circulated to the Chairman and all working group members.

8.1.2 Having considered the reports of the Chairman and the discussions during the session, the RA V-WGH members developed in accordance with the priority needs as identified in section 7.3 above. A detailed workplan including set of strategies/actions and expected outputs/outcomes is provided in Annex III of this report.

### **8.2 FUTURE RA V WORKING MECHANISM**

8.2.1 Realizing the importance of hydrological issues in the region and the vital role of WGH in assisting the region in water issues, the meeting agreed to recommend to the Regional Association V that the Working Group on Hydrology be re-established by XV-RA V for the next intersessional period to implement the Work Plan (2010-2013) in accordance to priority needs.

8.2.2 The meeting noted with thanks the valuable concrete work and achievements by Mr Charles Person in leading the Group and recognized with appreciation the considerable efforts he has made in fulfilling his duty as chairman. The RA V-WGH agreed that, in case Mr Charles Person will not be able to serve the group as Chairman for another period due to new national assignment with more responsibility, Indonesia could be considered as potential candidate to the chairmanship position.

8.2.3 The meeting also proposed that the structure for the Working Group on Hydrology including recommended Chairperson and experts to coordinate activities related to the identified priority regional needs. The proposed structure and TOR are as follow:

#### **GENERAL RESPONSIBILITIES (TERMS OF REFERENCE):**

##### **1. CHAIRPERSON (NEW ZEALAND / INDONESIA)**

###### **GENERAL TERMS OF REFERENCE:**

In his capacity as the Regional Hydrological Adviser to the President of RA V and as Chairperson of the Working Group on Hydrology will :

- Establish, in consultation with the president of RA V, the Working Group core members corresponding to the identified priority areas and the proposed coordinators and their Terms of Reference or responsibilities to assist in implementing the Work Plan (2010-2013).
- Coordinate the education, training and capacity building in hydrology and water resources with the aim to improve human resources capability in Region V
- Coordinate activities to raise the profile of National Hydrological Services (NHSs) and hydrology and water resources in the Region.

SPECIFIC TERMS OF REFERENCE:

In his capacity as Regional Hydrological Adviser:

- Assist the president of RA V in accordance with the duties stipulated in WMO General Regulation 167(b).
- Participate in Executive Council sessions, when invited representing regional interests in hydrology and water resources
- Coordinate the works of the Working Group on Hydrology with the Commission for Hydrology (Chy) and other regional Working Groups on Hydrology

In his capacity as Chairperson of the Working Group

- Coordinate the works of the Working Group on Hydrology among experts for each of the priority areas.
- Coordinate the implementation of the Work Plan (2010-2013)

**2. COORDINATOR RESPONSIBLE FOR WHYCOS (CHAIRPERSON)**

SPECIFIC TERMS OF REFERENCE:

- (i) Coordinate the regional and sub regional components of WHYCOS in RA V.
- (ii) Support the development of the SEA HYCOS and strengthening Pacific HYCOS.

**3. COORDINATOR RESPONSIBLE FOR CLIMATE CHANGE IMPACT ON THE WATER SECTOR (MALAYSIA)**

SPECIFIC TERMS OF REFERENCE:

- (i) Coordinate activities on climate change and climate variability related to hydrology and water resources sector including drought and flood forecasting in Region V.
- (ii) Support development of national and regional strategies for adaptation to climate change in the water sector.

**4. COORDINATOR RESPONSIBLE FOR QMF- HYDROLOGY (NEW ZEALAND)**

SPECIFIC TERMS OF REFERENCE:

- (i) Coordinate with the implementation of QMF-Hydrology in Region V.
- (ii) Promote the use of WMO manuals and Guidelines in Region V.
- (iii) Assist in standardization measures in Region V.

**5. COORDINATOR RESPONSIBLE FOR WATER QUALITY ASSESSMENT (SAMOA)**

SPECIFIC TERMS OF REFERENCE:

- (i) Coordinate activities on water quality monitoring and assessment in the Region.
- (ii) Support raising awareness on issues related to water quality.

## **6. COORDINATOR RESPONSIBLE FOR HYDROLOGICAL FORECASTING AND DROUGHT PREDICATION (FIJI)**

### **SPECIFIC TERMS OF REFERENCE:**

- (i) Coordinate activities on hydrological forecasting in Region V
- (ii) Take the lead in identifying available tools or methodologies including Geographic Information System (GIS), satellite information and hazard mappings for flash flood forecast.

The representative of the Secretariat informed the meeting that experts who are willing to be assigned as Rapporteur or Chairman for the Group should convey their interest to the Permanent Representative in their countries and request him/her to nominate them during the forthcoming XV-RA V, Bali, Indonesia 2010.

## **C. TRAINING WORKSHOP ON LOW-FLOW ESTIMATION AND PREDICATION**

### **1. BACKGROUND**

1.1 Sometimes river systems can have high water levels which can result in flooding. However, many communities depend on the availability of water through non-regulated river systems for their water supply. Therefore, periods of low flow are critical for managing their water resources. The main function of dams is to level out the fluctuations of high and low flows and to provide balanced water supply to meet demands. Knowledge of low-flow periods is therefore fundamental for reservoir design and site identification.

1.2 Many factors have an impact on the low-flow regimes of rivers. Whenever we change our land uses, we change the way in which water interacts with the landscape, and this can affect the water available in rivers, lakes and dams. Most nations are experiencing population growth, resource depletion and the over extraction of water. Low flows are critical elements in terms of meeting demands for often competing uses and requirements.

1.3 Considering the above facts, the WMO Commission for Hydrology (CHy) decided at its twelfth session (Geneva, October 2004) to prepare a manual on low-flow estimation and prediction to meet the identified needs of National Hydrological Services. The Manual on Low-flow Estimation and Prediction was published in 2009. The topic of the manual is of importance for the development and implementation of sustainable water resources management practices.

1.4 The Manual's objective is to publish state-of-the-art analytical procedures for estimating and predicting low river flows at all sites, regardless of the availability of observed data. It will be useful for many applications, including water resources planning, effluent dilution estimates and water resources management during low-flow conditions.

1.5 This Manual will be one of the technical guidance documents included in the WMO Quality Management Framework in Hydrology and discussed by the thirteenth session of the Commission for Hydrology.

1.6 In order to promote the use of the manual, WMO plans to organize a series of regional/sub-regional workshops to demonstrate the application of the methodology described in the manual. The first workshop in the series was organized during the 7<sup>th</sup> session of RA V-WGH.

## **2. THE WORKSHOP**

2.1 The last day of the session of RA V-WGH was devoted to a training workshop on low-Flow Estimation and Predication. Thirty five (35) participants from nine countries in the region including national experts from Indonesia representing various universities and water institution attended the training session.

2.2 The methodology described in the manual was presented chapter by chapter by Mr. John Fenwick from New Zealand. In his presentation, Mr Fenwick provided participants with various examples from New Zealand.

2.3 The first two chapters introduce the objectives, structure and major issues involved in predicting and forecasting low flows. Mr Fenwick indicated that other topics related to low-Flow Estimation and Predication are dealt with in more detail in other WMO publications. Chapter 3 discusses the data requirements for low-flow estimation, including river flow and associated basin properties, for example, soil type, hydrogeology and climate.

2.4 Chapter 4 presents key low-flow processes and the resulting wide range of low-flow response, an understanding of which is essential for analysing and interpreting low-flow information. Chapter 5 describes simple low-flow indices, including the 95% extra discharge and base-flow and recession characteristics.

2.5 Chapters 6, 7 and 8 provide step-by-step guidelines on estimating the flow-duration curve, extreme value distributions and the analysis of stream flow deficits, respectively.

2.6 Chapter 9 describes range of methods for estimating low flows at ungauged sites, including the use of short and nearby flow records to reduce the uncertainty of flow estimation. Chapter 10 presents key practical problems of how to estimate low flows in rivers influenced by artificial controls, such as abstractions, effluent returns and impoundments. Chapter 11 describes the main applications for which forecasts of low flows are required and presents methodologies for forecasting flows on a range of times scales. Chapter 12 presents a number of case studies on, among others, transboundary issues, a water resources decision-support tool, a regional approach to estimating small-scale hydropower and the estimation of residual flows below abstraction points.

2.7 Chapter 13 presents some significant conclusions and recommendations relating to data collection and capacity-building. Together with the techniques presented in the rest of the Manual, it is hoped that these conclusions and recommendations will reduce the uncertainty of estimating low flows and improve methods, for the benefit of all users.

## **3. CASE STUDY FROM INDONESIA**

3.1 Dr. Wanny Adidarma from Indonesia made a presentation on Low Flow Estimation and Predication - Drought Analysis in Indonesia. She presented the Low flow analysis in the past and recent low flow conditions and changes due to land use and climate change. The significant trend in rainfall time series indicated that climate change have an effect on it with the result the application of statistics and probabilities should be considered carefully. A decreasing of low flow series also pointed out that the land use change has already influenced the hydrological condition moreover the impact of climate change sometimes diminished the dry season rainfall.

It was realized that to reduce the drought risk, a prediction of drought level and drought-related impact should be performed. Unfortunately the unavailability of real time data monitoring represented major challenge to prepare draught predication.

#### **4. RECOMMENDATIONS**

4.1 Considering the nature of most rivers in the region, participants noted with appreciation the value of this manual in assisting NHSs to address data issues in the ungauged catchments in their countries and requested WMO to support national training workshop in the countries.

4.2 The time allocated to the workshop was not enough to provide more details and exercise in specific topics. Participant recommended that future workshop should be conducted in three days with some exercises.

4.3 Participants noted that this manual is a valuable document in WMO QMF in Hydrology and it was recommended to be widely used in the region.

### **B-2 THE 7<sup>th</sup> SESSION OF RA V WORKING GROUP ON HYDROLOGY CONTINUE**

#### **9. ANY OTHER BUSINESS**

9.1 The RA V – WGH members appreciated WMO's support to the participants to enable them to participate in the meeting and recognized the vital role of WMO's Sub-regional office in coordinating their activities. In this regard, the meeting recommended RA V to request the Secretary-General of WMO to urgently consider strengthening the sub-regional office with professional staff for water related issues as agreed to by XIII-RA V.

#### **Presentation on Future Research “FLOOD FORECASTING AND EARLY WARNING SYSTEM USING FEWS & IFAS**

9.2 Dr. Fransisca Mulyantari made a presentation on Flood Forecasting and Early Warning System using FEWS and IFAS. In his presentation, he noted that floods often occur in all parts of Indonesia and to address this problem there is need for flood early warning system. He added that not all the river basins in Indonesia are gauged basins and to develop Flood Early Warning System, satellite data are required as in-put to the models. RCWR in collaboration with Deltares developed FEWS to address flooding issues in Jakarta. A model was developed using satellite data. He briefed the RA V-WGH members about a pilot project for Drought Early Warning System (DEWS) using the Tropical Rainfall Measuring Mission (TRMM) from NASA and JAXA. The aim was to set up semi-operational drought early warning system which would enable the Research Centre for Water Resources (RCWR) to support Ministry of Public Works, concerning drought condition in Indonesia.

9.3 Dr. Mulyantari informed the RA V-WGH members about IFAS model which deal with flood forecasting and early warning system in poorly gauged basin with lack of hydrological and geophysical data, lack of runoff analysis engine, and difficulty of using flood-forecasting system. This model meets the Indonesian condition, which has many rivers but not all of them having good hydrological data. For this reason, IFAS will be useful in Indonesia and should be designed according to hydrological characteristic in Indonesia. This model will be applied in Solo River Basin in years of 2010 and other basins for the coming years.

9.4 Mr Tuwamin Mulyono, Deputy Director General of the Meteorology Climatology and Geophysics Agency (BMKG) – Indonesia made a presentation on Regional Training Centre Facilities and BMKG's Main Program including Indonesia Tsunami Early Warning System (Ina-TEWS) and Indonesia Meteorological Early Warning System (Ina-MEWS).

9.5 The Ina-TEWS consist of earthquake observation network, data processing system, and dissemination system. To monitor earthquake, 160 seismographs has been installed over Indonesian region with National Processing Centre located in Jakarta. In the case of earthquake occurrence, the earthquake information and tsunami early warning system are disseminated from the National Processing Centre to public through interface institutions such as police department, local government, National Disaster Management Agency, radio stations, TV stations, and printing media. Currently BMKG is capable for issuing earthquake and tsunami early warning within 5 (five) minutes after the earthquake occurrence. The Ina-TEWS was launched by the President of Indonesia on 11th November 2008. As part of the Ina-MCEWS, BMKG also established Jakarta Tropical Cyclone Warning Centre that has responsibility to monitor and issue warning for tropical cyclone over region of 0-100S and 900-1250E. The development of Ina-MCEWS is expected to be in operation by 2010

#### Technical visit & Field Trip

A technical visit was organized on the afternoon of Thursday 17<sup>th</sup> December 2009 to the Research Centre of Water Resources (RCWR) in Bandung.

9.6 A field Trip was organized on Friday 18<sup>th</sup> December 2009 to visit the experimental stations of RCWR in Bandung that are: Experimental Station for Hydrology and Water Management, Experimental Station for Water Environment, and Experimental Station for Hydraulic and Geotechnical. The RA V-WGH expressed appreciation to the host and thanked RCWR for organizing such education and technical excursion.

9.7 Participants noted with satisfaction the available facilities and existing experience in RCWR and requested WMO to cooperate with RCWR in organizing Regional Training courses using their facilities and expertise.

## **10. ADOPTION OF THE REPORT**

10.1 The Working Group adopted the report of its session and requested WMO Secretariat to make any editorial changes deemed necessary and to circulate it to all participants and Members of RA V. The WMO representative reminded the WGH members about the procedures before circulating the report. It was noted that WMO will finalize and circulate the draft report to all participants for comments. After incorporating all comments received in the draft, WMO will finalize and forward the final version to the Chairman of WGH for his action. The Chairman will forward the final report to the President of RA V for his approval to circulate the report. The Chairman will inform WMO about the President's approval and subsequently WMO Secretariat will circulate the Final approved version of the report to all participants.

## **11. CLOSING SESSION**

11.1 At the closing session, Dr Arie Moerwanto, Director of RCWR, on behalf of the government of Indonesia, thanked WMO for accepting RCWR's offer to host the 7<sup>th</sup> Session of RA V WGH in Bandung at the RCWR facilities. He also thanked the WGH members for their participation and exchanging their experiences with the Indonesian experts. He reaffirmed his country commitment to support other Members in the region to strengthen their national capacity

in the field of hydrology. He informed the WGH members that RCWR will continue working closely with WMO to ensure that the countries of the region are benefiting from the facilities and available expertise in the RCWR. He wished all participants safe journey back home.

11.2 Mr M. Tawfik on behalf of WMO thanked the Government and the people of Indonesia with special thanks to the management and staff of RCWR and BMKG for hosting and making such excellent arrangements which made the session very successful. He confirmed WMO continues support to the Pacific Island Countries NMHSs capacities. He informed participants that he will follow up the issue of recognizing RCWR as WMO regional centre on Hydrology with the concerned department in WMO secretariat. This follow up is to ensure that necessary action has been taken before XV- RA V session in Bali in April/May 2010.

11.3 On behalf of WGH members Mr. Christopher IOAN, Vanuatu, expressed the group thanks and appreciation to WMO and the Government of Indonesian in particular the BMK and RCWR for hosting and supporting the meeting. He observed that the meeting was successful and very useful as it offered good opportunity to learn and see the excellent facilities and expertise that is available in RCWR. He observed that hosting Hydrology and Water meetings in RCWR are of great value in promoting regional cooperation. He also thanked the staff of the RCWR for their cooperation and hospitality and the excellent support provided to the session.

## Annex I



### 7<sup>TH</sup> SESSION OF RA V WORKING GROUP HYDROLOGY, BANDUNG, INDONESIA 14-18 DECEMBER 2009

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SEVENTH SESSION OF THE REGIONAL ASSOCIATION V (SOUTH-WEST PACIFIC)  
PLANNING MEETING FOR SEA-HYCOS  
REGIONAL WORKSHOP ON LOW FLOW ESTIMATION AND PREDICTION  
**RCWR - LIST OF PARTICIPANTS**  
**(Bandung, 14 – 18 December 2009)**

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1	Mrs. Susan R Espinueva	Phillipines
2	Mr. Seremaia Koroi	Fiji
3	Mrs. Yohaslin Yusof	Malaysia
4	Mr. Lameko Asora	Samoa
5	Mr. Michael Maehaka	Solomon Island
6	Mr. Christopher IOAN	Vanuatu
7	Mr. Teotahi Adrian	Cook Islands
8	Mr. John Fenwick	New Zealand
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10	Yokito Sugimura	JICA
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17	Totok Suprpto	LAPAN
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32	Irfan Sudono	Pusair
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50	Mr. Mohamed Mahmoud Tawfik	WMO-Switzerland
51	Mr. Henry Taiki	WMO-Vanuatu

## RBOs and Universities – LIST OF PARTICIPANTS

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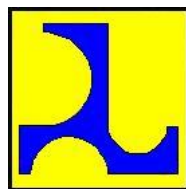
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## Annex II



RCWR



BMKG

### SEA-HYCOS PLANING MEETING

#### SEVENTH SESSION OF THE REGIONAL ASSOCIATION V (SOUTH-WEST PACIFIC) WORKING GROUP ON HYDROLOGY

#### REGIONAL TRAINING WORKSHOP ON LOW FLOW MANUAL

(BANDUNG, INDONESIA, 14 – 18 DECEMBER 2009)

### PROVISIONAL AGENDA

#### OPENING OF THE MEETING

#### 1. APPROVAL OF THE AGENDA AND ORGANIZATION OF THE WORK

#### A. PLANNING MEETING FOR SEA-HYCOS

1. THE WHYCOS CONCEPT
2. PRESENT STATUS OF HYCOS COMPONENTS
  - 2.1. Global overview
  - 2.2. Status report on Pacific-HYCOS
3. COUNTRY PRESENTATIONS
  - 3.1. Status of the observation and telecommunication networks
  - 3.2. Status of the data management systems
  - 3.3. Information requirements of the water sector stakeholders
4. IDENTIFICATION OF THE PRIORITY AND COUNTRY NEEDS
5. THE WAY FORWARD
6. CONCLUSIONS AND RECOMMENDATIONS

## **B. SESSION OF THE WORKING GROUP ON HYDROLOGY**

- 1. CONSIDERATION OF THE RELEVANT DECISIONS OF Cg-XV, XIV-RA V, CHy-XIII, AND EXECUTIVE COUNCIL SESSIONS**
  - 1.1. Fourteenth Session of the Regional Association V
  - 1.2. Fifteenth World Meteorological Congress
  - 1.3. Sessions of the Executive Council
  - 1.4. Thirteenth Session of the Commission for Hydrology
    - 1.4.1. *Adoption of Quality Management Framework for Hydrology*
    - 1.4.2. *INFOHYDRO*
    - 1.4.3. *Capacity building*
    - 1.4.4. *HOMS*
    - 1.4.5. *Climate and water issues*
- 2. OTHER PROJECTS AND ACTIVITIES RELEVANT TO HWRP IMPLEMENTATION**
  - 2.1. Assessment of the Performance of Flow Measurement Equipment
  - 2.2. Hydrological Forecasting
  - 2.3. Associate Programme on Flood Management
  - 2.4. WHYCOS and other cooperation projects
  - 2.5. Climate and Water issues
  - 2.6. Data exchange and Hydrological Information Systems
- 3. REPORT OF THE CHAIRMAN OF THE WORKING GROUP**
- 4. CONSIDERATION OF THE ACTIVITIES OF THE WORKING GROUP**
- 5. DISCUSSION ON THE IMPLEMENTATION OF THE HYDROLOGY AND WATER RESOURCES PROGRAMME IN RELATION TO THE NEEDS OF THE REGION**
  - 5.1. RA V Strategic Plan
  - 5.2. Contribution to CHy activities and other projects
- 6. DISCUSSION OF FUTURE ACTIVITIES OF THE REGIONAL ASSOCIATION V IN THE FIELD OF HYDROLOGY AND WATER RESOURCES**
- 7. ANY OTHER MATTERS**
- 8. ADOPTION OF THE REPORT**

## **C. CAPACITY BUILDING WORKSHOP ON LOW FLOW MANUAL**

- 1. INTRODUCTION**
  - 1.1. Use of low flow data in water management
  - 1.2. Understanding low flows and their causes
  - 1.3. Data requirement for low flow analysis
- 2. DESCRIBING LOW FLOWS**
  - 2.1. Low Flow Indices
  - 2.2. Flow-Duration curves
  - 2.3. Extreme Value analysis

### **3. LOW FLOW FORECASTING AND PREDICTION**

- 3.1. Estimating low flow at ungauged sites
- 3.2. Estimating low flow in artificially influenced rivers
- 3.3. Low flow forecasting

### **4. DISCUSSION AND RECOMMENDATIONS**

#### **CLOSING OF THE MEETING**

- 1. Adoption of the Report
- 2. Closing session

## Annex III

### RA V WORKING GROUP ON HYDROLOGY WORK PLAN ACTIVITIES (2010-2013)

Needs	Activities to address needs	Responsibility
Education, Training and Capacity Building	<ol style="list-style-type: none"> <li>1 Identify countries requirements for education, training and capacity building in HWR</li> <li>1. Organize regional training workshops for hydrology and water resources technicians in Region V</li> <li>2. Introduce e-learning to Members of Region V</li> <li>3. Designate Indonesia Research Center for Water Resources (RCWR) as WMO Regional Training Center (RTC) – Hydrology</li> <li>4. Promote WMO guideline and manuals related water resources through regional and national training workshops</li> </ol>	<p>Members of RA V WMO Secretariat</p> <p>WMO Secretariat</p> <p>WMO Secretariat</p> <p>WMO Secretariat Indonesia</p> <p>WMO Secretariat and Members of RA V</p>
Raising the Profile of NHSS	<ol style="list-style-type: none"> <li>1 Contribute to the manual on social and economic assessment on hydrology</li> </ol>	<p>Members of RA V</p>
SEA HYCOS	<ol style="list-style-type: none"> <li>5. Submit request to WMO to consider development of a SEA HYCOS.</li> <li>6. Prepare a concept paper for SEA HYCOS and then circulate it to Indonesia, Malaysia, Philippines and other interested Members of Region V seeking their consideration and approval of the concept paper</li> <li>7. WMO to prepare a full project document for SEA HYCOS</li> <li>8. Organize a regional meeting to discuss the project document with interested Members and donor agencies</li> </ol>	<p>Indonesia, Malaysia Philippines</p> <p>WMO Secretariat</p> <p>WMO Secretariat</p> <p>WMO Secretariat</p>



Pacific HYCOS	1. Carryout by an independent agency or expert an evaluation of the current project including its management, coordination, performance and deliverables in the countries	WMO and SOPAC
	2. To strengthen the Pacific HYCOS	WMO and SOPAC
Adaptation to Climate Change in the Water Sector	1 Assist members to develop adaptation strategies to climate change in water sector	WMO Secretariat
	2 Request WMO to assist Members of Region V on modelling of climate change	Members of RA V
	3 Contribute to establishment of appropriate water infrastructure in particular for SIDS	Members of RA V
Water Quality Monitoring and Assessment	1. Assist Members of Region V to participate in CHY activities related to QMF-Hydrology	WMO Secretariat Members of RA V
Maintenance and Calibration of Equipment for Hydrology	1. Designate Indonesia Research Center for Water Resources (RCWR) as WMO Regional Instrument Center (RIC).	WMO & Indonesia
Improving Flash Flood Warnings	1 Develop FFGS in Region V	WMO Secretariat Members of RA V
	2 Organise Training Workshop for Trainers in Region V	WMO Secretariat
	2 Promote IFM concept in Region V	WMO Secretariat
	3 Share information and experience of application of GIS/satellite tools to flash flood forecasting	Members of RA V
	4 Organise national synthesizing workshops for stakeholders	WMO Secretariat Members of RA V
5 Assist members of RA V to develop public awareness materials and provide these to members of Region V	WMO Secretariat Members of RA V	
QMF – Hydrology and Water Resources	1 Organize national and regional workshops raising awareness of ISO and WMO standard methods	WMO Secretariat Members of RA V