

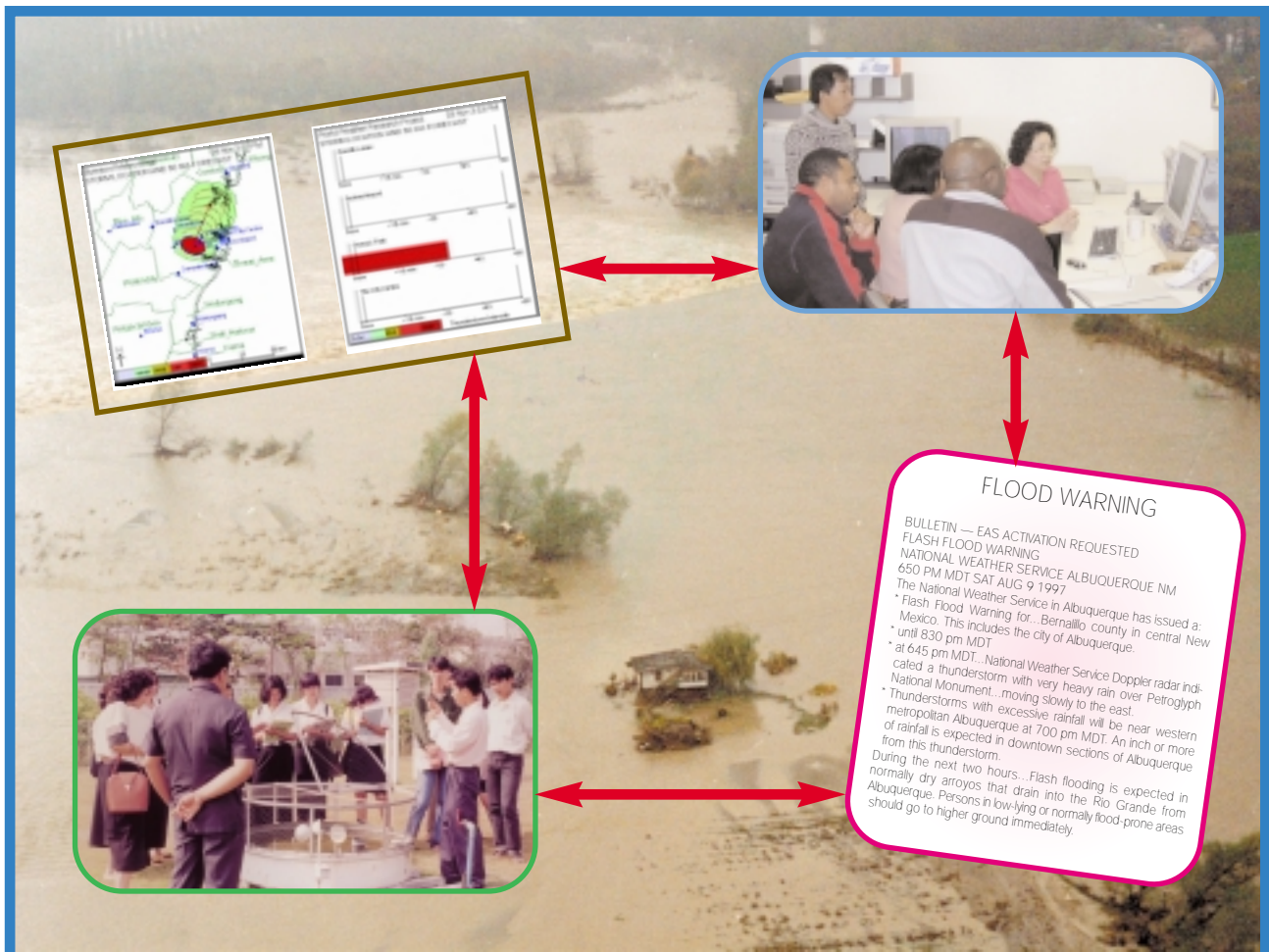


World Meteorological Organization

GUIDE ON IMPROVING PUBLIC UNDERSTANDING OF AND RESPONSE TO WARNINGS

PWS-8

WMO/TD No. 1139



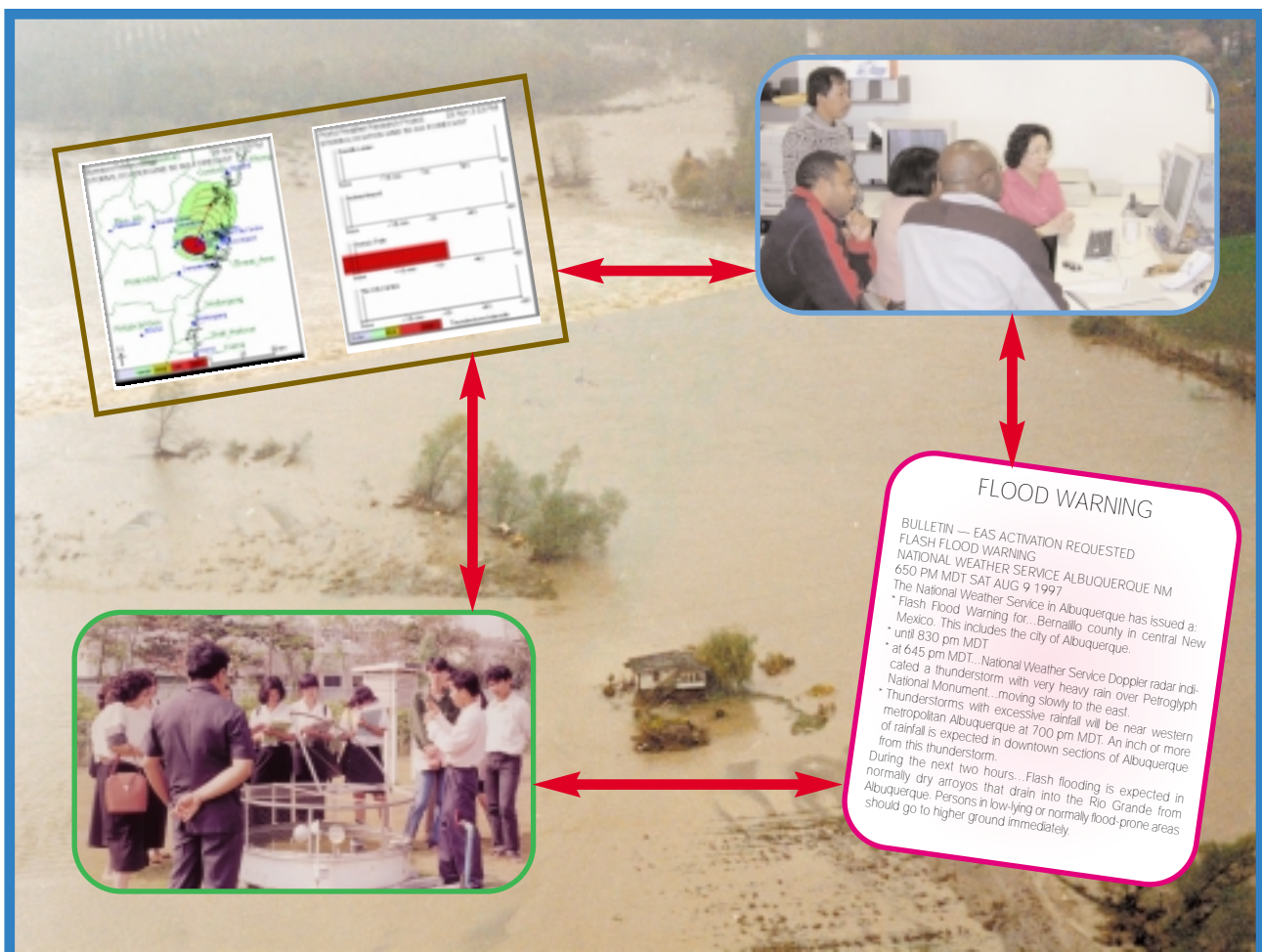


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Chapter 1

INTRODUCTION

This guide is intended to provide a useful reference for NMSs in their common goal to improve the public understanding of and response to warnings. It is not intended however that the complete set of guidelines being offered will be appropriate for adoption in every country. Moreover, it is acknowledged that most NMSs already have in place a range of measures to improve the public understanding of and response to warnings. These guidelines are therefore designed to prompt NMSs to increase their efforts.

Information contained in a number of relevant WMO publications is drawn on in the preparation of these guidelines. In particular, Chapter 9 of the WMO *Guide to Public Weather Services Practices* (WMO-No. 834). These guidelines effectively build on that WMO Guide by providing a diverse selection of practical ways to improve understanding of and response to warnings. A list of other publications is included at the end of the document.

In the Introduction to the WMO Guide to Public Weather Services Practices, it is acknowledged that warnings are only useful if they are received, understood, believed and acted upon by those at risk. To receive the warning information, users must be aware of the services available and be able to access them. To be understood the messages must be clear, concise, and presented within the appropriate social and cultural context. To be believed, the messages must be seen to be coming from a credible authority. The NMS must have a reputation for accuracy, reliability and timeliness. The warning messages must be delivered to a receptive audience, that is the population at risk must perceive a need for getting the warnings and have the willingness and ability to act upon them.

The primary objective of a warning system can be best summarized as follows:

“To empower individuals and communities to respond appropriately to a threat in order to reduce the risk of death, injury, property loss and damage. Warnings need to get the message across and stimulate those at risk to take action. An effective warning system will say to each member of the community at risk: What is happening : What it means to you : What you can do.”
(BoM/AEMI Workshop 1993).

The challenge confronting NMSs in the goal of improving public understanding of warnings is a complex one. The media is effectively the conduit between the NMS and the wider community and can influence the manner in which the warning is transmitted and received. To a lesser extent, this also applies to emergency managers, especially when ordering an evacuation ahead of the impact. In essence, the

need to improve warning understanding and response applies not only to the general public but also to an NMS's professional partners, in particular the media and emergency managers.

Although terminology is obviously important, there are other factors which are equally as important in generating effective action. Among the reasons for this is the fact that the community-at-large is a multi-cultural, economically-stratified and often mobile society. The approach must therefore be multi-disciplinary, involving advice from social science and human behavioural experts. The outcome is likely to be an enhanced public profile and improved credibility of the NMS.

In respect to warning production and external liaison, it is noted that many NMSs are consciously shifting from a predominantly science-centred approach to a more user-oriented philosophy. Nurturing partnerships with the media and emergency services is seen as an integral part of this change in corporate strategy.

In the present guide, it will be emphasized that response to warnings is most effective when the public receives an accurate, timely and understandable message from multiple credible sources, using all available communication channels. In the same vein, public awareness programs need to be conducted using a variety of approaches in consideration of the target audience.

In a recent conference paper, Dr David King* made the following important observation: “The communication of weather information is inevitably a top down process. Understanding of information and in particular, warnings about hazardous events involves a public safety transfer of knowledge from highly specialized scientists through emergency managers, local politicians and the media, to every member of society. Both the media and the general public select, re-interpret, and weigh up information about weather and hazards, applying a complex set of attitudes, perceptions, experience and misinformation to the initial message.”

Several significant trends are serving to enhance the prospects that warnings will be understood and appropriate protective action will be taken. These initiatives include greater use of graphical products to complement textual warnings, an increase in the number of live radio and television broadcasts by forecasters in severe weather situations, and the introduction of probability predictions in warnings issued by some NMSs. These trends will be highlighted in the guidelines.

* Dr David King is the Director of the James Cook University Centre for Disaster Studies. The above quote is drawn from his Keynote presentation at the Australian AMOS Conference, Melbourne 2002.

Chapter 2

UNDERLYING PRINCIPLES

The key to improving the public's response to, and understanding of, warnings is much broader than simply addressing the issue of terminology used in warnings. Although terminology is an important factor, other considerations are just as, or even more, significant. In addition to focusing on understandable terminology and in an effort to educate the public to the meaning of words used in warnings, NMSs are strongly encouraged to expend resources in non-meteorological areas. In working with partners in other fields, such as the media, emergency managers, and the social sciences, NMSs will increasingly appreciate how the public interprets and reacts to the warning.

NMSs are the experts on the meteorological aspects of weather-related hazards and risks. Traditionally, forecasters have relied heavily on their scientific expertise and vocabulary in preparing warnings, and may or may not have attempted to educate the public on the meaning of the words. In recent years however, several NMSs have recognized that a consideration of the social aspects of the contents and presentation of warnings is just as important as the meteorological content and accuracy. With this in mind, a number of NMSs are now moving towards a customer-centred approach to service and warning delivery. Writing warnings using common words understood by the public allows people to react in order to protect themselves from hazards. Throughout these guidelines selected "best practices" are featured as examples for other NMSs to consider implementing, or to generate new ideas to improve the public's understanding of and response to warnings.

To better understand how people respond to warning messages, NMSs are urged to collaborate with social and behavioural scientists and to incorporate their expertise concerning human behaviour into their warning approach and procedures. Advice from social scientists can be applied by modifying the format and presentation of the warnings themselves so as to stimulate an appropriate response and in the preparation of new or revised protective action statements to include in warnings. Such advice may also be useful when designing, modifying or developing promotional preparedness material and protective action strategies that are easily remembered and simple to act upon.

Much research in various disciplines has been published in the area of human response to warnings. This concept is known as the Integrated Warning System, and was first developed by social scientists researching warning systems. An excellent discussion on warnings systems and public response may be found in Mileti and Sorenson (1990) and Mileti (1999). This work is summarized below, and essentially forms the underlying principles of these guidelines that address the need to improve the public's response to and understanding of warnings.

There are three components to the Integrated Warning System, designed to reduce or eliminate the impact on people and property from any hazard:

- Forecast, Detection and Warning
- Dissemination and Communication
- Response.

2.1 FORECAST, DETECTION AND WARNING

This includes the scientific processes of analysing data; forecasting weather, water, and/or climate events; and preparing warnings. Detection considers data from numerous sources, such as surface and upper level observations, satellite and radar data, eyewitness reports, and so on.

2.2 DISSEMINATION AND COMMUNICATION

Dissemination is delivery of the warning message. However, communication is accomplished only after the information is received and understood.

2.3 RESPONSE

The warning message by itself does not stimulate an immediate response from individuals. People in a warned area first assess their personal sense of risk. The additional information required before they take action depends on the content and clarity of the initial warning and the credibility of the issuing organization. The potential for individuals to respond appropriately is dramatically increased if they are provided information to assist them in properly defining their personal risk and highlighting what life-saving and/or property-protecting actions to take.

Forecast, Detection and Warning and Dissemination are very familiar roles for NMSs, and are largely meteorologically and technologically based. Forecasters have traditionally not considered aspects of Communication and Response, and only relatively recently have considered integrating advice from social scientists to improve user understanding and response.

It is now well recognized that if a warning program is to be successful it must strive to ensure that every person or organization at risk:

- Receives the warning
- Understands the warning
- Believes the warning is real and the contents are accurate
- Confirms the warning from other sources or people
- Personalizes the risk associated with the warning
- Decides on an appropriate course of action
- Responds in a timely manner.

An individual's perception of risk is enhanced when:

- Warning messages before and during a particular event are issued and updated frequently
- The same warning messages are delivered by multiple credible sources

- Warning messages are consistent
- The basis for the warning is clear
- Suggested protective actions are included.

People respond to warnings when, and if, they can personalize the risk posed by the hazard. Therefore, warnings should be composed to allow the public to feel personally affected, by including:

- Detailed information about the threat
- Readily recognized location references, such as schools, highways, shopping areas, in addition to geographical and political references
- An explanation of the impact of the event and time before impact
- An explanation of the certainty/uncertainty of the event
- Specific actions for people to take to help themselves.

Response is expedited when an individual or group has a pre-determined plan of what actions to take for each hazard posing a potential risk.

These general guidelines should be expanded upon or adapted, to account for cultural differences. To integrate these underlying practices into their procedures and operations, NMSs are strongly advised to consider adding one or more “service representatives” to their administrative and operational staff, if they have not done so already. The service representative can serve as the primary link to the social scientists, the warning partners, and the customers, seeking to improve understanding of and response to warnings.

In the following chapters, examples of the practical application of these principles are provided to illustrate how various NMSs have used them in their warning service programs. Examples, such as those following, demonstrate “best practices” introduced by various NMSs to ensure that users of warnings understand the contents and respond appropriately to avert danger and minimize loss.

In the past, the Hong Kong Observatory adopted the scientist-centered approach to warnings, using rigidly-defined terms and then attempting to “educate” the public. This however turned out to be a formidable task and was never truly successful. A customer-centred approach is now adopted, in which the Observatory aims to write messages in an intuitively understandable manner and in such a way that people could react to and do what is necessary to protect themselves. The philosophy of the Hong Kong Observatory is that the meteorological service will adjust to the customer, and not the other way around.

The U.S. National Weather Service (NWS) has contracted with social scientists since the 1980s to understand how people respond to warning messages, to learn how to create warning messages that will stimulate an appropriate response, and to understand how to communicate preparedness messages which are memorable and actionable. Based on collaborations with social scientists, the NWS adjusted the format and content of its warning products and procedures and developed preparedness and educational material to enhance the understanding and response of warnings issued by the NWS. These changes are described below.

In the late 1980s, the U.S. NWS embraced the concept of an Integrated Warning System in its policy and procedural documentation, Weather Service Operations Manual (WSOM) C-49. This document has since been updated and reformatted into the latest policy document, now named NWS Directive 10-18.

Chapter 3

WARNING PRESENTATION

Warnings must be presented and delivered to the public so that they inform each member of the community at risk about:

- What is happening
- What it means to them
- What they can do that will enable them to minimize harm to themselves, their families and their communities.

To enhance the ability of the public to quickly understand warning information and react appropriately, forecasters at NMSs prepare weather warnings using text and/or audio and/or graphical formats for presentation across various electronic and print media. They must compress a great deal of information into standardized, concise and relatively brief messages for delivery to the public. Due to the need for brevity, the degree of detail in a warning can vary from message to message depending on its time span and the extent of the area to be warned. Utilizing a range of presentation platforms will also facilitate the use of warnings by people with disabilities – such as hearing and vision - to easily and quickly receive and understand the information. To minimize the risk of misunderstanding the warning messages and to maximize the opportunity for appropriate warning response it is essential that there is consistency in both the message being conveyed and the terminology used, across all presentation styles and formats.

3.1 CONSTRUCTION OF WARNING MESSAGE

When constructing a warning message forecasters should include:

- A heading that must ‘stand-alone’ and ‘stand out’ and clearly indicate the fact that it is a warning. It should accurately define the type of event and emphasize the severity of the event for example “Severe Thunderstorm Warning”.
- A “headline” which summarizes the most important message
- Non-technical information for public safety
- Technical information with supporting detail
- Appropriate protective action statements.

3.2 ORDER AND CONTENT OF WARNING INFORMATION

The order and content of warning information will vary both within and between events, it is important that those preparing warnings for public delivery use a structure and style which:

- Places the most important information first in the warning message
- Allows for unintended shortening of the message without losing urgency

- Changes the emphasis in the message content as forecast confidence and/or urgency of the threat increases
- Uses plain language, simple style and correct grammar to convey meaning accurately and make it easy for announcers to read
- Uses a caring, sensitive but arresting tone.

3.3 DETAILS OF WARNING CONTENT

In greater detail, an effective warning should include the following components:

- Warning title
- Date/time of issue
- Issuing source / authority
- Validity period
- Threatened communities or target audiences if not obvious in heading
- “Headline”
- Synopsis – indicate stage in development of event and provide protective action statements sourced from and attributed to appropriate authority
- Current intensity, location and movement of hazard(s)
- Forecast of probable development - intensity, location and movement of hazard(s) most likely impact area(s) and expected consequences
- Level of uncertainty or probability of occurrence
- Protective action statements (with appropriate attribution)
- Source(s) of further information
- Date/time at which or by which the next warning will be issued (as distinct from the issue time - i.e. allow time for distribution).

3.4 THE “KISS” PRINCIPAL

For warning messages that are to be broadcast/telecast via the electronic media – it is useful to apply the ‘KISS’ principal that is, Keep It Short and Simple.

- Three (3) lines maximum to a sentence
- Usually no more than 15 lines of text
- Get it across in 60 seconds or less.

3.5 THE WARNING CYCLE

Warnings must be initiated, updated, corrected, cancelled and retired as soon as the need arises – and renewed at a frequency commensurate with:

- The nature of the threat (e.g. intensity, duration)
- The available modes of communication
- The needs and expectations of the community, the media and emergency services.

3.6 CONSTRUCTING THE MESSAGE

Uncertainty may be conveyed with the use of words such as “if”, “then”, “may”, “should” and “could” (or similar meaning words and phrases in other languages and cultural contexts).

Warning messages should include information that allows people to confirm an impending event for themselves e.g. “approach of severe thunderstorm from the west” may be confirmed personally by visual observation or by personal communication with others.

Special care will be needed in framing a suitable warning for an unusual or extraordinary event which will be outside the experience of those communicating the warning and also the people that are likely to be affected.

There is an inherent degree of uncertainty in many meteorological events and there are many situations where there is insufficient information to forecast the severity of an event with any certainty. In these situations community confidence in the weather service may be increased with the issue of an additional level of warning – such as a Precautionary Flood Warning.

3.7 TERMINOLOGY

There are many different types of hazardous events with different time scales that are studied, forecast and monitored by a range of specialist and scientific organizations. The result is that a variety of hazard terminologies has been adopted across these organizations and there is often inconsistency in its usage.

All NMSs use terminology that has specific meaning in the context in which warnings are issued. While this meaning is clearly understood by forecasters preparing warning messages it is not always clearly understood by other organizations or the public.

If warnings are to be delivered effectively, it is important that NMS forecasters use standard terminology that clearly communicates the immediacy, reliability, severity and scope of the hazard and also of any basic response considered to be appropriate.

Terminology should have intuitive meaning so that visitors and new-comers to the threatened area will understand the degree of immediacy and level of severity of the threat.

Any specific terminology that may not be readily understood should be explained within the warning message. For example where the phenomenon or level of threat is categorized such as with tropical cyclones and hurricanes, where category systems are used, additional qualifying information is essential. This must be a “plain-language” description (e.g. major flooding which will probably be higher than the 1971 flood).

3.8 LANGUAGE

Where more than one language is commonly spoken in any country, the NMS should consider providing warning messages in those particular languages. A good example is Canada where the NMS delivers its warnings in both English and French.

In the Hong Kong Observatory bilingual forecasts in Chinese and English, are prepared using terms that are intuitively meaningful to the man in the street. The terms however are precisely defined for forecasters, to ensure consistency in presentation.

With the advent of the internet, a new measure has been put into trial. Terms in forecasts appearing in the website <http://www.weather.gov.hk> are programmed as hyperlinks to the corresponding explanations.

3.9 GRAPHICAL WARNING PRODUCTS

There is increasing demand by the public and the media for graphical presentation of warnings. Keeping in mind that “a picture is worth a thousand words”, graphical or pictorial products are now being produced by many NMSs to complement the textual warning. The existence and availability of a graphical product - which depicts both the path and extent of the hazard plus the warning area - increases the likelihood that the warning will be understood and acted upon by those communities under threat.

Graphical products may be delivered via both the electronic and print media and should necessarily be:

- Clear
- Simple and uncluttered
- Easy to understand
- In bold colours – it should also be remembered that colour blindness affects a significant proportion of the population
- Significant well-known geographical landmarks and landscape features shown
- Source acknowledged
- Time and date of production labelled
- Symbols and shades or intensity of colour explained in a key or legend.

Where possible, graphical products should be animated and interactive for use on television and the Internet

Graphics will be discussed further in Chapter 8, “Further Opportunities”.

The example in Figure 1 shows an Australian “Tropical Cyclone Track and Threat Map”

The map shows the past cyclone track, the Watch and Warning zones on the coast, and the radial extent of hurricane, storm and gale force winds.

3.10 PROBABILITY INFORMATION

A complete warning service should include the probability that the particular hazardous warning event will occur. Inclusion of the degree of uncertainty rather than just a go/no go forecast is becoming increasingly necessary to allow users to consider the cost of taking protective action against the potential cost of damage from the hazard. Warnings including probability information may initially be provided to special customers, such as industry and government agencies, in order to thoroughly test the concept before such information is included in warnings issued to the general public.

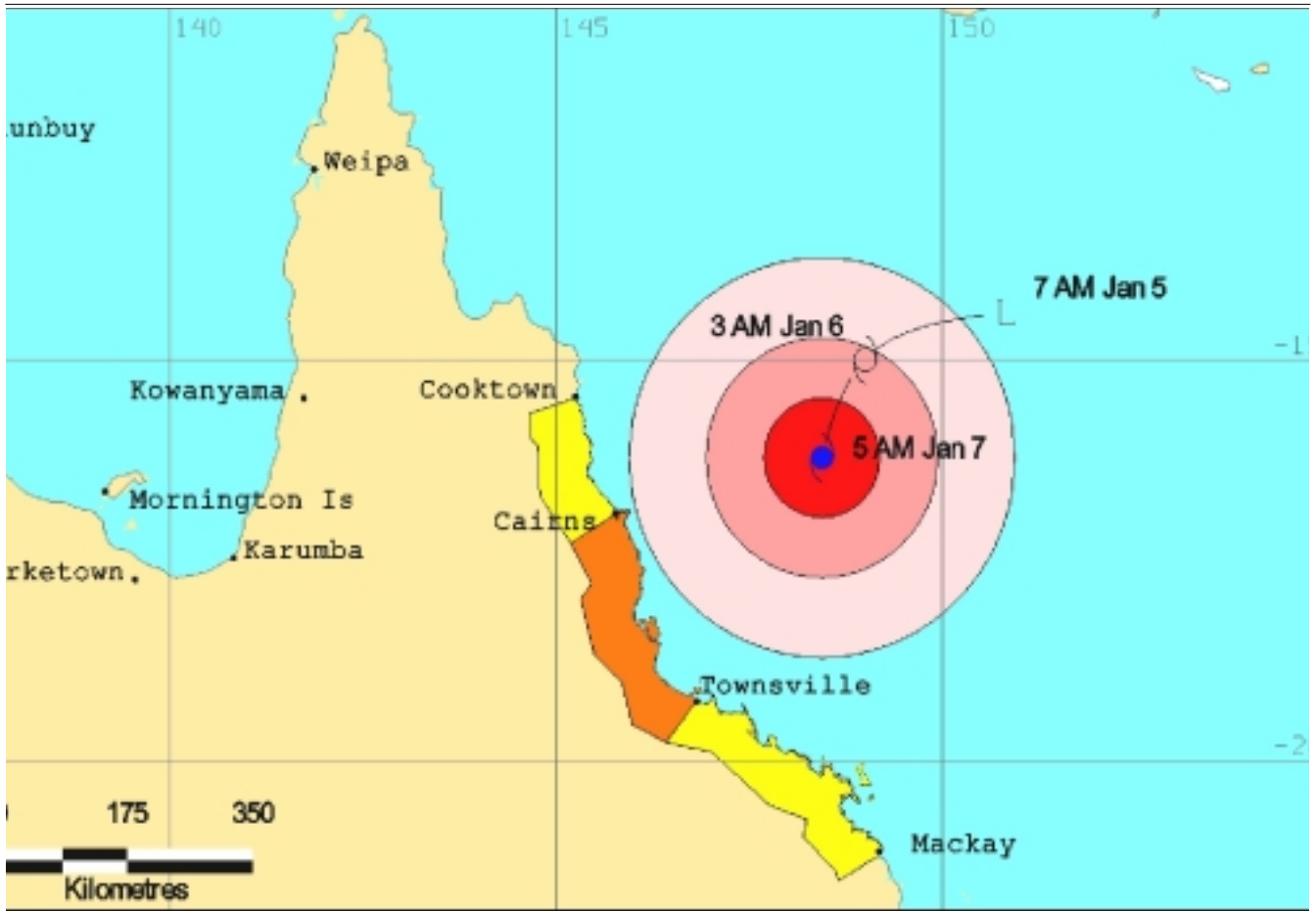


Figure 1 — Australian "Tropical Cyclone Track and Threat Map"

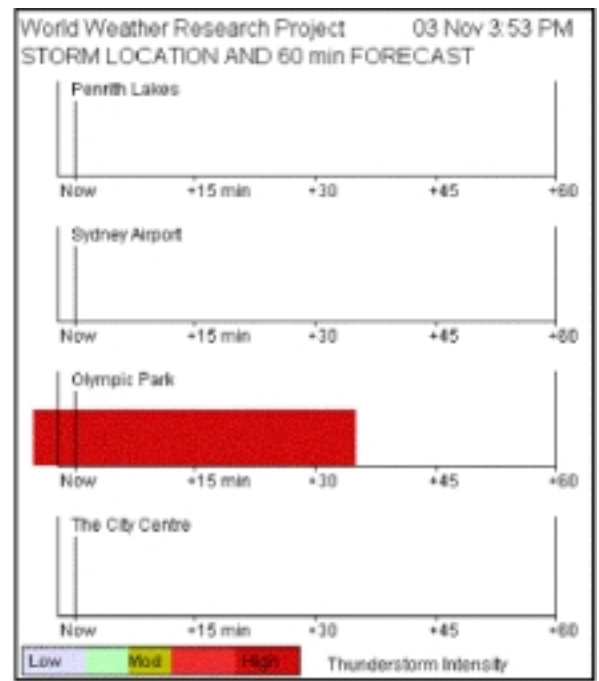


Figure 2 — Example of an Australian "Severe Thunderstorm Warning Display"

The following example comes from the UK Met Office.

EARLY WARNING OF SEVERE WEATHER

EARLY WARNING of Severe Gales and Heavy Rain

OVERALL RISK ASSESSMENT: The probability of disruption due to severe weather conditions in part of the United Kingdom within the next 24 hours is 80 per cent.

REGIONAL RISK ASSESSMENT for the occurrence of severe weather conditions between 21:00 on Monday 25 February 2002 and 12:00 on Tuesday 26 February 2002.

NORTHEAST ENGLAND	30 per cent
THE MIDLANDS	50 per cent
WALES	60 per cent
SOUTH WEST ENGLAND	70 per cent
CENTRAL SOUTHERN ENGLAND	60 per cent
SOUTHEAST ENGLAND	60 per cent
EAST ANGLIA & LINCOLNSHIRE	60 per cent

All other regions less than 20 per cent.

This is the first warning of disruption due to Severe Gales and Heavy Rain.

(Note that the warning also included a synoptic summary and various action statements.)

3.11 REAL-TIME METEOROLOGICAL INFORMATION

The “public” that access public weather services is evolving into a diversity of sub-sectors, ranging from the illiterate to the highly intelligent and knowledgeable. At the intelligent and highly weather-literate end of the spectrum there is greater demand for real-time meteorological data relevant to current weather conditions, particularly those that relate to localized information on wind and rain. Many NMSs now make such information from their Automatic Weather Stations available on their Web sites. In most instances this has been found to strengthen the credibility of the NMS and build increasing confidence in the weather service among the Internet user community. An example of a real-time data display from the Australian Bureau of Meteorology is shown below.

3.12 PRESENTATION FEEDBACK

Essential to maintaining an effective warning system is receipt of customer feedback and the willingness and responsiveness of an NMS to act on that feedback if change is warranted.

There are a number of ways of obtaining feedback on warning services:

- Monitor radio and television programs during an actual event while warnings are being issued

Current Observations

Station Name	Date Time (AEST)	Temp (°C)	Dew Point (°C)	Rel Hum (%)	Wind Dir	Wind Speed (km/h)	Wind Speed (knots)	Wind Gust (km/h)	Wind Gust (knots)	Press (hPa)	Rain since 9 am (mm)
Brisbane	13 15:44	22.2	-7.5	13	WSW	17	9	28	15	1012.1	0.0
Brisbane Airport	13 15:45	22.3	-14.2	7	WSW	24	13	37	20	1012.3	-
Archerfield	13 15:45	22.2	-9.6	11	SW	24	13	37	20	1012.1	0.0
Amberley	13 15:45	22.3	-18.1	5	W	24	13	26	14	1012.7	0.0
Gold Coast Seaway	13 15:30	19.2	2.6	33	E	18	10	24	13	1012.4	0.0
Cape Moreton	13 15:00	20.2	-4.1	19	SW	20	11	28	15	1012.8	0.0
Spitfire Channel	13 15:30	-	-	-	WSW	20	11	28	15	-	-
Inner Beacon	13 15:30	-	-	-	W	24	13	30	16	-	-
Banana Bank	--	-	-	-	-	-	-	-	-	-	-
Maroochydore	13 15:30	22.1	-10.9	10	SW	18	10	28	15	1012.7	0.0
Gatton UQ	13 14:57	20.6	-6.1	16	WSW	28	15	48	26	-	0.0
Toowoomba Airport	13 15:00	15.6	-7.9	19	WSW	31	17	43	23	1015.8	0.0
Oakey	13 15:00	17.6	-12.6	12	WSW	33	18	44	24	1015.3	0.0
Coolangatta	13 15:30	19.1	1.6	31	ENE	15	8	20	11	1012.2	0.0
Tewantin	13 15:00	21.8	2.0	27	E	15	8	20	11	1012.4	0.0
Nambour	13 15:00	22.2	-5.6	15	WNW	11	6	20	11	1012.6	0.0
Beerburum	13 15:00	22.5	-7.3	13	WSW	9	5	18	10	-	0.0
Toolara AWS	13 15:00	25.4	-6.0	12	W	18	10	30	16	-	0.0
Jimna Forestry	13 15:00	17.7	-9.2	15	S	15	8	37	20	-	0.0
Gympie	13 15:00	23.6	-9.7	10	WSW	18	10	30	16	1012.4	0.0
Double Is Pt	13 15:00	21.9	7.7	40	ESE	13	7	17	9	1012.3	0.0

Example of a real-time data display from the Australian Bureau of Meteorology: Current Weather Details for the Brisbane Region

In 1998, the U.S. NWS changed the format of short-fused warnings to a standard bullet style to enhance the public's understanding and response, based on Mileti and Sorenson's research. The new format applies to warnings for tornadoes, severe thunderstorms, flooding and flash flooding, and marine weather hazards, and are documented in Weather Service Operations Manual C-40, "Severe Local Storm Watches, Warnings, and Statements" (see references), as well as other policy chapters. The standard bullet format provides succinct information regarding "what, where, why, how to respond", in this order:

attribution (example: "The National Weather Service in [location] has issued ...")

- type of warning and location of area to be warned
- valid time
- time...basis for warning...movement
- pathcast (optional)
- brief concluding paragraph
- recent history of event
- additional information
- call-to-action (public response) statements

Each bullet is a maximum of six lines of text, using non-technical terms the public can understand. Forecasters are encouraged to include any recent reports of damage, as they confirm the threat in the minds of the public.

- Survey affected communities in the aftermath of a significant impact
- Consult directly with the media and emergency services at any time including a combined debrief following a significant impact
- Conduct public surveys on an occasional or opportunity basis
- Survey electronically via the NMS Web page.

Chapter 4

WARNING DISSEMINATION

In the event of meteorological hazards, the NMS is the sole warning authority for its citizens. As stated in the underlying principles, to generate an appropriate response, it is important for users to believe that the warning is real and the contents are accurate. One way to accomplish this is for the user to receive the same consistent warning from multiple, credible and trusted sources. For example, when a warning has been issued, a user may receive the warning via radio, and then turn on the television or refer to the Internet to get confirming or additional information before making a decision to act. Therefore, to enhance user response, it is vital that all sources disseminating the warning are basing their announcements on the same official information.

Three key factors that need to be considered when disseminating a warning message are:

- Choice of communication channels
- Frequency of warnings
- Following up.

4.1 CHOICE OF COMMUNICATION CHANNELS

Channels for delivering warning messages should have the following characteristics:

- Timeliness
- Reliability
- Backup
- Accessibility
- Feedback
- Effectiveness
- An authoritative originator.

To maximize the chances that warnings will be received NMSs are strongly urged to disseminate warnings via multiple communication channels. Certain channels may be more accessible or more effective than others in reaching the people or organizations at risk for a particular hazard.

Examples of formal and informal dissemination methods and networks the NMS should have access to in real, or near-real, time include:

- Television (broadcast, text crawlers, on-screen icons, news breaks)
- Commercial or public radio (including emergency interruptions, such as the U.S. Emergency Alert System)
- Live crosses or interviews (TV or radio)
- Dedicated weather radio network
- Internet
- Facsimile
- Press
- Sirens
- Public address systems
- Door knocks
- Press releases
- Amateur radio
- Marine radio

- Weather radio
- Law enforcement or emergency management networks
- E-mail
- Cell/mobile phone
- Short message service (telephone)
- Wireless application protocol (WAP)
- Recorded phone message
- Telephone trees
- Information centres
- Community, ethnic, or religious leaders
- Direct phone consultation with NMS staff.

Warnings are most effective when targeted at just the people at risk. If people not at risk are warned, it is likely that they will tend to ignore future warnings.

Warning information should be disseminated in a wide variety of formats (text, graphical, audio) to enhance the capability of people with hearing and vision disabilities to receive and understand the information. In addition, warning information should be presented in multiple languages, as indicated by local demographics.

NMSs should take advantage of emerging communication technologies, especially the Internet and wireless applications, such as pagers, mobile phones, and personal digital assistants, to deliver warning information directly to people when they need and where they want to receive it. These new technologies provide NMSs with unprecedented access directly to the public. The format of messages intended for these devices must be simple, brief, and standardized, so that they can be disseminated, received, decoded (if necessary) and displayed with no need for human intervention.

Some segments of the population require special consideration when exploring ways to improve warning response. These groups include those people in facilities and institutions such as schools, prisons, old-age homes and hospitals. It is likely that these groups would require more time to respond to a threat than required by the general public. Warnings could be communicated to people in these facilities and institutions through the use of hailer or loud-speaker systems.

Special populations with unique warning needs also live in non-institutionalized settings. Among this group are elderly people with reduced mobility, people who cannot understand the language used in the warning, and individuals with sight or hearing impairment. The best approach in these cases is for the emergency services (or another government agency) to maintain a register of people with unique warning needs. Then if say an evacuation or other significant protective action is required – emergency service (or government) personnel would contact those people by telephone or in person as appropriate. Where applicable, consideration can also be given to translating warnings into several languages. This is already being successfully done by a number of NMSs around the world, including Canada NMS.

4.2 FREQUENCY OF WARNINGS

A decision on warning frequency needs to take account of the:

- Nature of the threat
- Intensity of the threat
- Duration of the threat
- Available modes of communication
- Needs and expectation of the community.

Warning frequency for each hazard is traditionally specified in an NMS's operational guidelines, although decision processes about frequency must be sufficiently flexible to accommodate unforeseen changes in the nature of the threat.

Forecasters should appreciate that it is not too late to issue a warning even after a hazardous phenomenon develops. Such a warning will usually provide some lead-time for communities likely to be affected by the hazard. Even a late warning reassures people that the national weather service is aware of current weather trends and helps to defuse external criticism.

4.3 FOLLOWING UP

In places where the reliability of communications cannot be guaranteed it is essential that a process for "following up" is in place to ensure that warning messages have been received and understood by the various media. NMSs can make arrangements for "following up" by liaising with media to negotiate a set of mutual expectations to be implemented during a severe event. It is wise to also include a review of the process so that any short-comings can be quickly identified and if possible rectified.

In the unfortunate event of a major forecast failure where a warning was warranted (with the benefit of hindsight) but not issued – or a where a warning was issued comparatively late, well after the initial impact, it is essential a careful and considered explanation of the reasons for this failure be presented in the public arena. Doing this adds an element of credibility to the warning system and assists the public to appreciate the inherent limitations of the science of forecasting in the present era.

4.4 EARLY WARNING DISSEMINATION OF WARNINGS FOR SPECIAL USERS

Some NMSs have found that it is helpful to some selected government and emergency services agencies as well as operators of public utilities such as airports, ferries, buses and trains if they are given advance alert of coming warnings, even if by as little as a few minutes. This allows them to organize and/or mobilize necessary response personnel in advance of the public reacting to warnings. This is particularly useful when the public's reaction to a warning

translates immediately into a demand on public services. Any decision to issue advance notice of issue of a warning should be negotiated and organized with partners and be a 'standing arrangement' prior to warnings being issued. In Australia, the State Emergency Services in New South Wales receive special severe storm warnings with both graphic and text forecasts of storm tracks, on a dedicated Web site at the same time that the public warnings are issued. Just prior to this they are advised, by fax, that the issue of a warning is imminent.

Officers of the Hong Kong Observatory present routine TV weather programs broadcast by local TV stations. These weather programs are produced in a studio at the Central Forecasting Office. Web versions of these programs are also available on the Internet.

In the U.S., the NWS partners with other government agencies and non-government organizations, private weather companies, and the media to deliver and communicate NWS forecasts and warnings to the public. The NWS has limited direct delivery of this information to the public, primarily via the Internet and the network of weather radio stations across the country. In addition, the private sector weather companies may provide their own forecasts, which often vary from the NWS forecasts, to their own customers. However, with warnings, the NWS and its government and private partners consistently provide warnings issued by the NWS. This consistent delivery to the public of critical warning information and advice from multiple credible sources is essential in alerting the public to the hazard and eliciting an appropriate response.

The U.S. has a national Emergency Alert System (EAS) to allow the NWS and other government officials access to radio and television stations to simultaneously broadcast weather and non-weather emergency messages to the public. Using digital protocols, including codes to identify the key elements of the message, NWS warnings and other local, regional, or national emergency messages are automatically relayed through radio, television, and cable television stations, even if those facilities are unattended. When EAS is activated, participating radio and television stations interrupt routine programming, and broadcast an attention-grabbing signal, followed by the message. Many television stations also periodically run a text crawl summarizing the warning on screen and/or continuously display a warning icon on screen throughout the effective period of the warning. NOAA Weather Radio is the entry point for the NWS to the EAS. EAS messages are limited to two minutes or less.

Chapter 5

WARNING RESPONSE

Advances in weather forecasting and mass communications technologies have resulted in warnings being delivered to populations at risk with increasing timeliness and accuracy. This however, does not guarantee that warnings will be successfully acted upon, as this is largely a function of how the threatened population perceives the risk of the hazard and the physical and intellectual resources that can be drawn upon.

Successful response to warnings – that is, where warnings prompt effective and timely risk minimizing actions, will only occur when:

- Warnings are as accurate as the science allows,
 - Warnings are understood by the population at risk,
 - Warnings are disseminated in time for those people to protect themselves,
- and most importantly
- The warning message is personalized and believed by the people at risk,
 - People receiving the warning willingly take defensive actions.

Successful response to warnings is most likely to occur when the people receiving the warning messages have been educated about the particular characteristics of the hazard, are familiar with the extent of damage that could result and have personalised the risk. The willingness and ability of the population to respond effectively to warning messages is, to a large degree, dependant on how successful public education campaigns have been and how well the populations receiving the warnings have prepared. NMSs should consider working with social scientists to understand the social and cultural dimensions of the communities that they are preparing warnings for, particularly in relation to how the hazard risk is both perceived and understood. Advisory statements on how to respond to warning can then be constructed to reflect community characteristics and understandings.

To ensure the population has sufficient knowledge to understand the various weather related hazards and the associated risks, public education campaigns should be conducted by NMSs on a regular and as-needs basis. This is well recognized and is now common practice in many NMSs (this is discussed further in the following chapter).

Defensive action statements, or recommended response actions are issued by most NMSs together with the detail of the warning. The preferred approach is to develop suitable defensive action statements for each hazard in collaboration with emergency services, thereby increasing the credibility and authority of the advice when heard by the threatened population. Suitable attribution of the action statements should be given within the warning as this raises the likelihood that the public will willingly follow the advice.

It is preferable that clear and simple-to-follow instructions regarding recommended response actions accompany the warning message. Alternatively a clear directive of where response action statements can be found should be included

In some societies cultural and religious practices limit the movement of some sectors of the population (notably women) at various times during the year. This may be reflected in an unwillingness to respond to an advice to evacuate.

In the mid-1990's the Australian Bureau of Meteorology (BOM) was concerned that people living in tropical cyclone prone areas in Far North Queensland were not responding to advice to prepare their properties for the cyclone season and it was feared that, in the event of a cyclone warning, they may not respond to warning advice messages. Working with social scientists at the Centre for Disaster Studies, the BOM investigated the community attitudes and awareness of cyclones. It was discovered that a significant proportion of the community believed that the local topography and geography naturally protected the area from cyclone impact. Furthermore, very few people demonstrated any basic understanding of storm surge. It was apparent that many people did not believe they were at risk of cyclone impact and did not understand all the consequences of such an impact. Subsequent public education campaigns focussed firstly, on explaining cyclone processes and why the local topography did not 'protect' the area and secondly on describing and explaining storm surge. Consequently, the people in the cyclone-prone communities now have a better understanding of the risk and are demonstrating a greater willingness to prepare and carry out recommended preparatory and defensive actions for cyclones and the cyclone season.

in the warning, for example people may be directed to a Web site, a recorded telephone message or another authority such as local government offices or emergency services.

The examples of response statements listed on the next page illustrate the type of information that is included with Australian Tropical Cyclone warnings to assist the public better understanding the warning and evaluating the risk and thus assist in their appropriate response.

People are more likely to personalize the risk and respond quickly and effectively to warning response advice messages if these messages have local relevance and meaning. The two examples of warning response advice messages on page 12 are from the Australian BOM. They are issued in real time with the warning and add valuable information that informs people about what is likely to happen in their area and what they should and/or should not do. Both examples are from the Australian NMS.

Similar advice messages are issued by the Hong Kong Observatory progressively as tropical cyclone /typhoon warnings are issued (see page 13). In most cases the

RESPONSE STATEMENTS

A. Cyclone Watch Zone – with no areas under Cyclone Warning

People between ... and ... should consider what action they will need to take if the cyclone threat increases, and listen to the next Advice at ... am/pm. If you are unsure about actions to be taken, information is available from your local government or local State Emergency Service.

B. Cyclone Warning Zone – Category 1 Only

People between ... and ... should take precautions and listen to the next Advice at ... am/pm. If you are unsure about precautions to be taken, information is available from your local government or local State Emergency Service.

C. Warning Zone – Category 1 nearing or making landfall

People between ... and ... should remain inside until the cyclone has passed and listen to the next Advice at ... am/pm.

D. Warning Zone – Category 2-5 - no SEWS

People between ... and ... should immediately commence or continue preparations, especially securing boats and property (insert "using available daylight hours" or "before nightfall" as appropriate).

E. Warning Zone – Category 2-5 - with SEWS

People between ... and ... should complete preparations quickly and be prepared to shelter in a safe place. Boats and outside property should be secured (insert "using available daylight hours" or "before nightfall" as appropriate).

F. Category 2-5 – nearing or making landfall - no large Storm Tide

People in the path of the (dangerous) cyclone should stay calm and remain in a secure shelter while the (very) destructive winds continue. Do not venture outside if you find yourself in the eye of the cyclone - (very) destructive winds from a different direction could resume at any time. Heed the advice and follow the instructions of Police or State Emergency Service personnel.

G. Severe TC – nearing or making landfall - with large Storm Tide

People in the path of the very dangerous cyclone should stay calm and remain in a secure shelter - above the expected water level - while the very destructive winds continue. Do not venture outside if you find yourself in the eye of the cyclone - (very) destructive winds from a different direction could resume at any time. Follow the evacuation advice or directions of Police or State Emergency Service personnel.

AUSTRALIA

Recommended Actions included in "Severe Weather Warnings"

Very heavy rain currently falling between Gladstone and Bundaberg is expected to cause localised flash flooding in the next few hours. People are advised to keep clear of creeks, storm drains and flooded roads.

Damaging wind gusts up to 100 km/h are expected during the night. People are advised to put vehicles under cover or away from trees, secure loose objects and move themselves and pets indoors away from windows. Beware of fallen trees and powerlines.

Dangerous surf conditions with waves exceeding 5 metres in the surf zone are likely with significant beach erosion and possible damage to buildings. People are advised to stay out of the water until seas abate.

High tides expected this evening and Saturday morning may be up to half a metre higher than the highest tide mark of the year. Residents and campers in low-lying seaside areas are advised that they may experience salt-water flooding and should consider moving to higher ground.

Protective action advice in this warning has been recommended by the State Counter Disaster Organisation. For further information or for emergency help in floods and storms, ring your local police or State Emergency Service.

AUSTRALIA

Recommended Actions included in "Severe Thunderstorm Warnings"

The State Emergency Service advises that as storms approach, people should put vehicles under cover or away from trees, secure loose outside objects and move themselves and pets indoors away from windows.

During and after storms, people should take extreme care when driving and beware of fallen trees and power lines. If flash flooding occurs, avoid flooded roads and water courses.

If your house is damaged, contact your local State Emergency Service on 132 500 for emergency assistance. Do not use the telephone during the storm.

**T.C. No. 1
Part 3** Tropical Cyclone Bulletin – Signal No. 1
(Precautionary Announcements)

- (1) Some precautions against damage should be taken now, gutters and drains should be cleared of obstructions. Hinges, bolts, locks and shutters of windows and doors should be checked
- (2) People living in wooden huts and in low-lying areas should take necessary precautions against strong winds and flooding.
- (3) Listen to your radio or watch your TV for further weather information.
- (4) Those who have definite duties during a tropical cyclone should now remain on call or contact their control centres from time to time.
- (5) If you are planning to visit Macau, any of the off-shore islands or remote parts of Hong Kong, you are reminded that changes in weather may affect your plans.
- (6) Since sea state is / may be very rough, you are advised to stay away from the shoreline and not to engage in water sports.
- (7) Engineers, architects and contractors should make sure that scaffolding's, hoardings and other temporary structures are secured.
- (8) Owners of small craft should ensure that their moorings are in good conditions and adequate, and take any precautions they consider necessary.
- (9) Owners of shop signs, advertisements and TV aerials which overhang public thoroughfares or which are situated on tops of buildings should make sure that the fastenings and framework of these structures are secured.

**T.C. No. 9
OR 10
Part 3** Tropical Cyclone Bulletin – Signal No. 9 or 10
(Precautionary Announcements)

- (1) Do not go outside. If you are reasonably protected, stay where you are and keep well away from all windows. Close all interior doors and make sure children are confined to the least exposed part of your home. On no account should you touch electric cables that have been blown loose.
- (2) Stay away from exposed windows and doors because glass, already under strain from wind pressure, will shatter if a flying object should hit it. Make sure you have a safe place to shelter, should windows be broken. You should only fix broken windows and doors when there is no danger in doing so.
- (3) If the eye of the typhoon passes directly over Hong Kong, there may be a temporary lull lasting from a few minutes to several hours. This will be followed by a sudden resumption of violent winds from a different direction. Remain where you are if protected and be prepared for destructive winds and the change in wind directions. Listen to broadcast warnings.
- (4) Since seas are very rough, / high, / phenomenal, you are advised to stay away from the shoreline and not to engage in water sports.
- (5) You must arrange to get * home or to a safe place immediately.
[* Delete the words "home or" if Rainstorm Black Warning is in force.]
- (6) If you are away from home # and cannot return fairly soon, find a safe place and remain there until the danger is over.
[# Delete the words "and cannot return fairly soon" if Rainstorm Black Warning is in force.]

recommended actions are intuitive and ‘common sense’. These should be re-enforced throughout the public education literature. In all cases they must be ‘doable’; that is they must be within the capacity of the people at risk to successfully complete.

Warning response advice messages may be issued for a range of severe weather events where people can take defensive action that will minimize loss and harm to themselves and others in their community. As these messages are issued in real time with the warning they should have the period for which they are relevant clearly defined. The example shown at right was prepared for release by the Hong Kong Observatory.

Direct personal hazard experience is a powerful decider in how people respond to hazard threats and warnings. Almost as powerful is the direct personal experience of loved ones and close friends who can share their experiences and the lessons they learned. If possible, a warning should include comparison with a well-known historical event where the same or similar hazard was experienced. The warning may refer to a historical impact in the area presently under threat – or an impact elsewhere but one likely to be recalled by the population now at risk. This provides a useful benchmark to assist people in response decision-making. For example a flood warning may include mention of inundation levels in a past flood and relate this to current expectations of forecast flood levels.

Consideration should be given to the use of a distinctive siren to announce or introduce a warning if a very significant event is expected. This serves to immediately catch the attention of the population at risk, and reduces the likelihood the warning will be overlooked. The siren may be heard on the electronic media, as is the case in Australia where the siren is referred to as the Standard Emergency Warning Signal (SEWS). Alternatively, it may be a hailer on an emergency service vehicle that could be a signal to people in a storm surge zone to evacuate ahead of a cyclone impact. A siren should only be used in the most serious emergency situations, usually when impact is imminent.

People will act and react appropriately to warning advice and defensive action messages, and will therefore effectively minimize loss and harm, if they have a sound understanding of the hazard and a realistic perception of

Very Hot Weather Warning

(First issued)

The Very Hot Weather Warning has been issued by the Hong Kong Observatory at

_____ a.m. / p.m.

(Re-issued)

The Very Hot Weather Warning is now in force.

The Hong Kong Observatory is forecasting very hot weather / with / high humidity / and / light winds / in Hong Kong today / tomorrow / in the next few days. The risk of heatstroke is high.

When engaged in outdoor work or activities, do drink plenty of water and avoid over exertion. If not feeling well, take a rest in the shade or cooler place as soon as possible.

The Hong Kong Observatory advises that prolonged exposure under sunlight is to be avoided. Loose clothing, suitable hats and UV-absorbing sunglasses can reduce the chance of sunburn by solar ultraviolet radiation.

Swimmers and those taking part in outdoor activities should use a sunscreen lotion of SPF 15 or above, and should re-apply it frequently.

Cancellation :

The Very Hot Weather Warning was cancelled at _____ a.m. / p.m.

the risk. The advice they are given must be delivered in a timely way and in a format that is clear and easily understood. Recommended defensive actions must be within the capacity of the people receiving the advice to carry out; that is they must have the physical and intellectual resources to willingly carry out all recommended defensive actions.

Chapter 6

PUBLIC EDUCATION

It is well recognized that people are more likely to act on warnings and weather forecasts when they are weather literate and well informed. Therefore, in addition to the traditional mission of, “providing accurate weather forecasts and effective warnings on inclement weather”, most NMSs also include a recognition of their role and responsibility in promoting public awareness and preparedness for natural disasters in their mission statements. Many NMSs commit significant resources toward enhancing the public’s understanding of their services function, responsibilities, facilities and operations, the nature and associated risk of the weather phenomena, and raising the public awareness and preparedness of natural disasters.

A range of educational products and services designed to support public education campaigns in delivering information that will help raise peoples understanding and awareness of hazards, inform them about how to best respond to warnings and ultimately promote individual and community hazard mitigating behaviours, are now available in most countries.

Public education campaigns should aim to provide current and background information on hazardous weather events as well as weather and related climate issues. Public education campaigns are generally more effective when they are carried out by an NMS weather services in partnership with other emergency and management agencies. Best practice, effective hazard awareness education campaigns will only be achieved within dynamic and diverse communities by applying a range of educational approaches.

Hazard awareness education aimed at enhancing community warning response must address a diversity of community information needs. These may be broadly considered in two bands:

- Real time education
- Public awareness initiatives.

6.1 REAL TIME EDUCATION

Many NMSs include recommended appropriate preparatory and defensive actions with the warning message. These are contained in short, simple, supplementary messages that advise people facing an immediate threat about short term strategies that will help them avoid harm and protect themselves and their properties. It has already been mentioned in previous chapters, but is worth reiterating that, they should only recommend defensive actions that are within the capacity of the people receiving the warning to carry out. People should be confident that acting on these recommendations will, in fact, improve their situation and effectively minimize their losses. These recommended actions are most successful when they have been developed in consultation with warning partners, particularly emergency services agencies. Sources of additional

supportive information should be indicated and the source of all information contained in these messages must be acknowledged. This is the approach that is currently used by the U.S., Australian and many other NMSs.

Supplementary real-time education may be made available to the public during a warning period as text, via TV crawlers, faxed messages, the Internet, telephone SMS messages, in newspapers etc; by voice via radio, recorded telephone message, at interview on television, personal telephone communication with forecasters, loud halers etc; or as graphics via television, fax, the Internet etc; or, as is most common, in combination particularly via the television. Particularly successful are TV and radio presentations when NMS forecasters are interviewed by local and well-known media personalities. These interviews may be either pre-recorded or ‘live’. The interactive nature of such interviews gives weather specialists the opportunity to add information and explanation to both warning and supplementary advice messages.

In Australia community service messages (similar to the one shown in the example on the next page) which describe phenomena, local impacts and response actions in some detail, are distributed to various media for their information and for public presentation.

It must be remembered that the role of the various media is two-fold. They are a target audience for NMSs in that they require education to raise awareness concerning the kinds of information that is available. They are also the main transmitters of weather warnings and weather information to the public and they therefore play a vital role in the successful implementation of NMS public awareness and education activities and warning delivery.

Real time education is particularly effective because it is presented when people are aware that they are in need of information about the particular threat they are facing and are actively seeking it. They are receptive to advice that will be of relevance in the current situation and in any future events.

The media’s reporting of events, as they are occurring, also presents an opportunity for effective real-time education. Unfortunately this opportunity is rarely used well. In both the print and electronic media, reporting of hazardous events is usually within the context of ‘bad news’. It is usually sensationalized and frequently (albeit) unintentionally supports inappropriate behaviours in its ‘news coverage’ that does not deliver any useful defensive action messages. For example, images of people bike riding, fishing, swimming in, and walking and driving through flood-waters, and surfing in wild seas.

6.2 PUBLIC AWARENESS INITIATIVES

The aim of public awareness initiatives is to raise public awareness of the risk associated with meteorological hazards,

 **BUREAU OF METEOROLOGY**
Queensland Region
Tropical Cyclone Warning Centre

Media: Please broadcast this message periodically throughout days when Tropical Cyclone Advises are current

COMMUNITY SERVICE MESSAGE
Issued at 12:45pm on Wednesday the 23rd of December 1998

Tropical Cyclone Advises and other weather warnings are available on the recorded Telephone Service:

1300 659 212 at the cost of a local call.

The text of Tropical Cyclone Advises may be obtained on facsimile by polling the Bureau of Meteorology's WEATHER BY FAX service on 1302 93 5273 (60c per minute).

A Threat Map may be obtained by polling 1302 93 5277 (60c per minute).

People in threatened areas are urged to listen carefully to all official advisories. Note especially whether you are located in the watch or warning zone.

A Tropical Cyclone Watch means a Tropical Cyclone is expected to produce wind gusts of at least 100 km/h in one or two days time.

A Tropical Cyclone Warning means a Tropical Cyclone is expected to produce wind gusts of at least 100 km/h within 24 hours or that a Tropical Cyclone Centre is directly affecting the coast.

An estimate of cyclone severity is included in Tropical Cyclone Advises. Categories range from '1' for a weak cyclone to '5' for the most severe.

Cyclone Tracking Maps and information on Tropical Cyclone Advises are included in all coastal Queensland telephone books. For details see the white pages of the following directories:

- Page 21 in the 1998/1999 Cairns directory
- Page 18 in the 1998/1999 Townsville directory
- Page 16 in the 1998/1999 Mackay/ockhampton directory
- Page 21 in the 1998/1999 Maryborough/Bundaberg directory
- Page 21 in the 1998/1999 Sunshine Coast Directory
- Page 42 in the 1998/1999 Brisbane Directory
- Page 17 in the 1998/1999 Gold Coast Directory

Example of an Australian community service message

describe and recommend appropriate defensive actions and ultimately give people the opportunity to develop strategies that will minimize the hazard risk for them personally and for their communities. People's perception and understanding of hazard risk is determined by a range of individual and community characteristics and attributes, the most powerful of which is direct personal experience and specific hazard education.

Public awareness initiatives may be introduced to the community in public education campaigns at any time, and should be ongoing. Most NMSs intensify campaigns of seasonal hazards such as storms, tropical cyclones, hurricanes, tornadoes etc just prior to the beginning of the season and generally continue through to the end of the season.

The most effective time to introduce hazard awareness education is during, or immediately following, a hazardous event that has been either directly and personally experienced or has occurred in a similar area or community, as this presents the greatest opportunity for individuals to 'personalize' the particular hazard risk. This underscores the need for NMSs to have educational products prepared and ready for delivery during these periods and to have built up a good relationship with emergency managers and hazard 'experts',

educators, media presenters, reporters and other partners that may support various public hazard awareness initiatives. When the public is 'hungry' for information the media will deliver whatever is available to it (this is generally true of all modes of mass media).

In addition to the traditional mission of many NMSs, "providing accurate weather forecasts and effective warnings on inclement weather", the mission statement of the Hong Kong Observatory is to "promote public preparedness for natural disasters". Accordingly, the Hong Kong Observatory puts a fair amount of resources toward enhancing the public's understanding of the nature of the weather phenomena, facilities and operation of the Observatory, and raising the awareness and preparedness of the public of natural disasters. A TV documentary was produced for this purpose in the past couple of years, and another, focused on disaster preparedness is being made. The Observatory staff also give public lectures on weather-related issues, as well as contribute to special columns in newspapers, writing about weather phenomena, the relation between weather and day-to-day living, as well as human interest stories.

Hazard awareness education should be delivered in a range of formats via a range of media. Methods commonly used for communicating the various types of hazard awareness information include:

- Pamphlets/Brochures/Leaflets
- Media packages Television, Radio, Newspaper
- Internet
- Public meetings/pre-season tours
- Schools and other educational institutions
- Shows/exhibitions
- Service representatives.

6.3 PAMPHLETS/BROCHURES/LEAFLETS

These are relatively cheap to produce and distribute widely. They can be delivered to households in letterboxes or as inserts in local papers, or be picked up in convenient popular locations such as shops, banks, weather offices, markets etc. These are commonly kept on hand in households for reference during a warning period. They should contain concise information that is simple and instructive, rather than detailed and descriptive, and consistent with information derived from other credible sources. They are particularly successful when produced jointly with partners such as emergency services and local government and focus on a single issue, for example, storm surge or protecting caravans in high winds etc. Common-use language should be used rather than jargon, and symbols and graphics should be clear and bold. Where possible brochures should be colourful and look interesting. Pamphlets, brochures and leaflets must include statements indicating the source of the information and the authorities responsible for their production and distribution and sources of further information.

The UK Meteorological Office developed and printed a booklet explaining warning criteria methodology and potential impacts. This booklet has been distributed to 300 individuals and organizations who have responsibility for public welfare and the country's infrastructure. The Met Office expects to update this booklet in the winter of 2002/2003.

The Hong Kong Observatory has prepared publicity pamphlets describing each type of major warning, its purpose, the meaning of the different levels of that warning, and advice on precautionary measures to be taken when the warning is in effect. The pamphlets may be obtained freely from the Observatory Resource Centre which is conveniently located near the Central Forecasting Office. The same information is also available on the Observatory Web site, and as brief radio and TV publicity segments for broadcast.

6.4 MEDIA PACKAGES

Much of what people know about hazards is from secondary sources, particularly the print and film and television media. Unfortunately media reports of natural hazards events almost always appear within the context of 'bad news'. They are frequently biased, misinformed and sensationalized and commonly focus on dramatic images which emphasize the element of human suffering and generally perpetuate popular disaster 'myths' such as problems of panic, disorganization, hysteria and looting. Often the drama and image replaces the truth and content, especially the science, of a news event. It is rare for televised real-time disaster reports to include defensive action messages to educate the viewing public for future events. This is unfortunate as people are particularly receptive to such messages at this time.

Television is a primary media of choice for accessing and/or confirming weather forecast information and is second only to radio in the case of weather warnings. Overwhelmingly residents choose to access weather forecasts on the television where the presentation is graphical and usually animated and the information is 'personally' delivered by the television stations 'weather-person'. Television documentaries can provide detailed information about various hazards and are often a successful way of providing hazard and disaster preparedness information. When the viewer can personalise the situation being televised the information is readily believed. Short video clips that focus on an upcoming hazard season can be prepared ahead of time and televised as needed.

Public radio is widely accessed by the general public in most countries and is usually the preferred media for receiving and/or confirming hazard-warning messages. This is probably due to a community perception that radio is more reactive and responsive to 'update' messages. Post disaster studies have consistently found that live interviews by a trusted local media commentator with emergency managers and hazard specialists prior to, during and in the immediate post hazard impact periods are extremely effective. Community residents are receptive to both the information and the advice offered, particularly when it is perceived to have been derived and delivered from a local source. Well-handled live-to-air interviews are an excellent means of both communicating hazard information and building community trust in those delivering the hazard information and managing the hazard 'situation'.

In Australia most regional radio stations broadcast a daily weather segment which includes a live-to-air interview with a forecaster from the regional weather office. The forecaster discusses the current forecasts and weather outlook in the local context, explains weather terms and discussed interesting weather phenomena.

6.5 INTERNET

The Internet is becoming an increasingly valued, and more widely used source of weather information and hazard data. It is therefore becoming an increasingly effective way of delivering hazard awareness education. Amongst people that use

the Internet there is a perception that information discovered via the world wide web is current, abundant and generally credible. It is significant that specific user-groups, such as backpacker tourists and retirees on caravan holidays, emergency services volunteers, surfers, recreational fishers etc., are becoming familiar with the technology and are 'surfing the net' to access detailed specialized weather and warnings information. Many NMSs are responding to this trend and making their Websites more user friendly and their weather information more easily accessible. Care must be taken however, to ensure that the same quality of information that is being made available on the Internet is also available via other sources so as not to disadvantage those without access to this modern technology.

6.6 PUBLIC MEETINGS

Most NMSs present weather information to the general public and specialist user groups at public meetings and user forums on a regular and on an as-needed basis. They may be organized well in advance and must be appropriately advertised. They should be conducted at a convenient time at a well known and easily accessed venue. These gatherings enable the public to interact directly with weather specialists and to have their specific issues directly addressed. These are generally more successful when carried out in partnership with other organizations.

In Australia, the BOM staff and key emergency service personnel tour cyclone and flood prone areas of northern Australia prior to each wet season to brief the public and stakeholders on their risk from the hazard, the warning and response systems in place, and the services provided by the BOM. Similar tours are conducted in the United States prior to the beginning of hurricane season each year.

Training for special user groups:

The NMS may provide specialized training in weather and weather warning issues for special user groups. Particularly those that have defined responsibilities and public duties in warning periods.

The UK Met Office cooperates with examining bodies, such as the Royal Yachting Association, in reviewing and refreshing licensing examination material related to knowledge and interpretation of weather charts and broadcasts.

The Hong Kong Observatory recognizes the importance of partnerships with downstream organizations that have to deal with the public in weather hazards, such as emergency relief offices, transport operators, school management, swimming pool management, etc. Special workshops or seminars are arranged for them to clarify the meaning of warnings as required for the coordination of proper response to weather warnings.

6.7 SERVICE REPRESENTATIVE

NMSs can improve their public awareness activities by effective use of their existing staff. For example, a Service can designate and develop a staff member as a public "focal point" or "Service Representative" who is involved in the entire process of working with the users, to assess their requirements, to develop products and services to meet their expectations and last but not least to educate them on how to make the most of the information and services provided. Due to the overlap of some tasks, the public focal point could also be designated as the warning coordination meteorologist.

In the US the NWS has created a special position for a Warning Coordination Meteorologist who is responsible for overseeing the warning program and the provision of public awareness education

6.8 SHOWS AND EXHIBITIONS

A stand at a show, fair, or exhibition is a good way for the NMS to advise the public of the range of services it provides. If possible, modern technology in computers, satellite imagery and radar imagery should be on display to enhance the image of the NMS as scientific and up to date. An officer from the local weather service should be available to answer public concerns and questions. Brochures and other printed materials should be available for interested members of the public to take away with them.

The BOM in Australia stages weather exhibits in local shopping centres in the city and country, as well as at marine, industry and agricultural shows. Forecasters staffing the exhibits, promote the BOM's services and respond to questions asked by the passing public.

The U.S. NWS exhibits at similar shows, including air shows and conventions, such as the American Meteorological Society and the National Association of Broadcasters. Staff from U.S. forecast offices have also set up exhibits at local shopping centers and county fairs. A range of informative brochures and pamphlets are made available at these shows. In addition, the U.S. NWS frequently features live Internet access to their web pages at these shows, to demonstrate where citizens can go to get weather information in which they are interested.

6.9 OPEN DAYS

Many NMSs support open days at their forecast facilities. This provides a dual opportunity for the NMS staff to meet with their client and for the public to see the forecast operations and talk directly to the NMS staff. Open Days can be

scheduled to coincide with other special events, such as World Meteorological Day, Earth Day, the anniversary of an historic disaster, severe weather awareness week, etc. Visits by schools or university groups can help to foster interest and understanding among tomorrow's generation.

Guided group tours of the Hong Kong Observatory are arranged throughout the year for the community with secondary school students as the main target group.

6.10 SCHOOL-BASED EDUCATIONAL PACKAGES

Hazard awareness education and information materials are widely available throughout the adult community. Children, on the other hand, are only able to access and process the information presented to them. They are therefore dependent on schools and the adult community for all their hazard awareness education. This is particularly true of primary school age and younger children. School curriculum studies in most countries include some hazard awareness education in both primary and early secondary school. The extent and depth and content varies and may be largely left up to the discretion of the responsible school systems and teachers. NMSs can support school-based hazard awareness education by contributing to the development and production of educational packages to be included in curriculum studies and by forecasters visiting schools and delivering presentations to students and their teachers and being available to answer their questions.

The BOM in Australia, in partnership with the James Cook University Centre for Disaster Studies, has produced 'Stormwatchers' an interactive CD Rom game that informs primary school students about tropical cyclones, instructs them on appropriate preparatory behaviours for the cyclone hazard, and teaches them of what they can expect of a cyclone experience. The game has been distributed to all primary schools in tropical cyclone prone regions and is included in the curriculum studies.

The BOM focuses attention on school visits to forecasting and observing sites by students between the ages of 12 - 16 years.

The UK Met Office has an active and motivated team responsible for promoting meteorology in schools and colleges. That team has researched the schools' curricula, and in conjunction with professionals, has designed and produced relevant material. A well-developed web site (www.metoffice.com/education/index.html) contains information and resource material. In addition, hard copy resource material is advertised and sold directly to schools. An experimental package in Braille, to assist children with visual impairments, has recently been produced.

Educational resource material, a virtual tour of the NMS facilities, and specially designed computer games are available on the Hong Kong Observatory Web site. Guided group tours of the Hong Kong Observatory are arranged throughout the year for the community with secondary school students as the main target group.

Chapter 7

IMPORTANCE OF PARTNERSHIPS

The key to establishing, raising or changing hazard awareness and improving warning response in hazard-prone communities lies in NMSs, in partnership with others in the emergency management and the scientific community, effectively communicating hazard risk as - opposed to simply delivering (or making available) information about hazards. Only then will people in these communities be in a position to make informed decisions about the level of risk they face and what preparatory and defensive actions they may choose to take to minimize this risk.

It is vital therefore, for NMSs to develop and maintain strong partnerships with a wide variety of government agencies and non-government agencies to accomplish their mission of protecting life and property. All partners must understand their respective roles and responsibilities and how they fit together in a complementary manner to accomplish the common goal of delivering accurate, timely, and understandable warnings to the public. The general public benefits from a strong partnership between warning partners. Working together, as partners, reduces the likelihood that hazards will become disasters.

The NMS warning partners include:

- Federal, state, and local government agencies involved with the warning process and infrastructure, including NHS, where that is a separate agency from the NMS
- Emergency managers or coordinators
- The media
- Private sector weather companies
- Emergency relief agencies, such as the Red Cross

- Non-government organizations
- Emergency responders, such as police and rescue
- Storm spotters
- Amateur radio groups
- Schools and academic institutions
- Social scientists
- Meteorological societies (formal, such as the American Meteorological Society, and informal, such as Friends of the Hong Kong Observatory)
- Businesses.

For many NMSs, media partners, especially radio and television, play a vital role in communicating the warnings directly to the public. The various media are important sources for the public to receive warnings in a timely fashion. Broadcasters not only present the warning, but can provide additional explanation and context to personalize the information for their listeners/viewers. In addition, in some countries, the NMS staff themselves have arrangements in place to allow them to broadcast live during a warning situation, speaking directly to the public. For example, during severe weather events, film crews come to the forecast office to allow meteorologists at the BOM in Australia to brief TV audiences. These segments are usually pre-recorded and broadcast later, but can be broadcast live for major severe weather events.

As stated in the underlying principles, this consistent delivery of warnings from multiple credible sources such as the media, emergency managers, civil authorities, law enforcement, etc. increases the chances that the public will act upon the warning appropriately.

In the U.S., a new public-private partnership, named the Partnership for Public Warning (PPW), was incorporated in January 2002. The PPW is a private not-for-profit institute which includes private sector and government entities at the local, state, and federal levels, addressing many of the same concerns as are addressed in these guidelines. This organization brings U.S. experts in emergency warning (not limited to weather warnings) together to facilitate the development of new and enhanced emergency warning systems that save lives and protect property. Some broad areas of interest the PPW is addressing include developing national standards for warning messages (including terminology); developing common emergency message protocols; recommending national priorities to improve emergency warning content and delivery. In the summer of 2002, the PPW is also preparing a National Strategic Plan for Public Warning. For more information on the PPW, see their web site at www.partnershipforpublicwarning.org.

The Hong Kong Observatory established a group named "Friends of the Observatory" in 1996. Membership has grown to more than 3800. It consists of members of the public who are interested in the work of the Observatory. Comments and ideas of the members have been useful in identifying the needs of the public, especially in the understanding of forecast and warning services, resulting in an improvement of the quality of the service from the NMS. Activities of the 'Friends of the Observatory' include regular science lectures, visits to Observatory Facilities, publication of newsletters, and consultative meetings.

The UK Met Office partnered with the Environment Agency, who are responsible for issuing warnings of flooding from main rivers, on a national awareness campaign to improve the public's understanding of the warning codes and to be prepared to take action to minimize damage. It is generally accepted that the campaign was successful in meeting its objectives. However, it should be noted the campaign costs about £1 million per annum for on-going reinforcement of the message.

In 2002, the U.S. NWS adopted the theme "Working Together to Save Lives." This theme is prominently featured on the NWS web pages, on posters and displays used for exhibits, in outreach material, and in many speeches, presentations, and interviews with the NWS personnel. This theme enables the NWS to highlight and publicly recognize their essential relationships with their warning partners.

The BOM in Australia works closely with the Australian Center for Disaster Studies. This partnership includes a post-doctoral position provided by the Center for Disaster Studies to work directly with the BOM for a three-year period.

In the U.S., numerous government agencies and non-government organizations have formed a partnership named the National Disaster Education Coalition (NDEC), to coordinate multi-agency disaster-related outreach

material with consistent themes. Members of NDEC are: American Red Cross, the Federal Emergency Management Agency (FEMA), NOAA/National Weather Service, National Fire Protection Association, U.S. Geological Survey, Institute for Business and Home Safety, International Association of Emergency Managers, U.S. Department of Agriculture Cooperative State Research, Education, and Extension Service. Most of the U.S. NMS' efforts in awareness and preparedness are accomplished through partnerships with other agencies and non-government organizations having a similar mission to save lives and protect property (such as the American Red Cross, FEMA, U.S. Geologic Survey, the Weather Channel, etc.).

The benefits of this approach are in the:

- sharing of costs of development and printing
- ensuring a consistent message from multiple credible sources
- yielding wider distribution of material from many outlets.

In the United States, the NWS initiated a community-based preparedness program named StormReady to promote hazard awareness and preparedness as an active collaboration among federal, state, and local emergency management agencies, the public, and the NWS. This collaboration supports better and more consistent hazard awareness and mitigation efforts among communities at risk.

The StormReady program recognizes local communities that have developed the communication and safety skills necessary to save lives and property. StormReady communities are approved by a board whose members represent the NWS, the Federal Emergency Management Agency, the National Emergency Management Association, and the International Association of Emergency Managers.

Recognized StormReady communities:

- disseminate forecasts and warnings to the public
- monitor local weather conditions
- conduct public readiness seminars
- have a formal hazardous weather plan to train weather spotters
- have a plan conduct emergency exercises.

As of June 2002, there were 392 StormReady communities in 40 states, with the goal to have one in all 50 states by September 2002.

The StormReady program concept has recently been expanded and now includes tsunamis affecting the five U.S. states with Pacific coasts, in a program named TsunamiReady. TsunamiReady helps community leaders and emergency managers strengthen their local tsunami operations. TsunamiReady criteria are more stringent than StormReady criteria, so all TsunamiReady communities are also StormReady. As of January 2002, there are three TsunamiReady communities in two states.

Chapter 8

FURTHER OPPORTUNITIES

Further opportunities to improve public understanding of and response to warnings will be addressed under the following broad areas:

- Greater use of the Internet and other modern technologies
- More emphasis on public education
- Development of more collaborative partnerships with key stakeholders
- Inclusion of uncertainty/probability information in warnings as appropriate

8.1 INTERNET AND OTHER TECHNOLOGIES

Ways of making greater use of the Internet (text, image, audio, video) are described in detail in the WMO *Guide to Public Weather Services Practices*, Chapter 9, Section 4.9. The use of graphics on the Internet can be particularly appealing to the visually-oriented younger generation. The Internet as one of the more recent developments in information technology can also be used as a valuable communications channel to distribute information material. In fact an NMS should empower or encourage people to search the Internet for relevant material on its warning systems. Although use of the Internet is expanding at a phenomenal rate there are still significant populations without access, so care must be taken to ensure that quality of weather information and warnings is not polarised into those that have the Internet and those that do not.

Video-streaming is a special use of the Internet to transmit information on video. Typically in the context of weather, a warning prepared for television might be made available on the Internet after transmission, where it could be accessed by the public at their own convenience

Wireless Application Protocol (WAP) is a standard for transmitting interactive content over mobile phone networks, and is technology that underlies the convergence of Internet and mobile phone technology. The concept is to receive web pages in a simplified format on the display of a mobile phone. A warning distributed through WAP has advantages over the Internet with reception available at any time and anywhere.

8.2 PUBLIC EDUCATION

Warning and hazard awareness education will be more successful when it has local relevance and delivered locally. This should be relatively easy to achieve by ensuring that such information is regionally specific rather than more generalized.

Strategic use can be made of television weather segment for informing about warnings and meteorological hazards. This is often the most watched segment of the television news and viewers are generally paying attention. Concise warning and hazard information could usefully replace the public

service and community announcements that are frequently included in this segment.

More effective use could be made of live-to-air interviews on both radio and television during the time of hazard impact and in the immediate post impact period. Warning specialists along with emergency managers should be prepared for such interviews with information and advice being provided which is relevant to the existing situation, and also potentially useful for mitigating future hazard impact.

8.3 STAKEHOLDER PARTNERSHIPS

Local government authorities should be accessible and accountable to residents for the hazard awareness education available in their communities. These authorities should ensure that their representatives are fully and currently informed. In-house workshops and information sessions presented and delivered by warning specialists and emergency management experts should be supported on a regular basis. Timely debriefings attended by all stakeholder agencies after significant events are also important.

Collaborative and cooperative public hazard awareness education campaigns are more effective and stronger than those that are produced and delivered by a single institution, with a greater likelihood of success. Local area context and relevance are essential.

The production of operational manuals for one or more key partners, such as the media and emergency management agencies should be considered. Each year just prior to the cyclone season, the Australian Bureau of Meteorology provides the media with documentation describing the warning system and the expectations of the Bureau in respect to the broadcast/telecast of cyclone warnings. The NMSs of several European countries have also made progress in this area.

8.4 PROBABILITY INFORMATION

The case for inclusion of uncertainty/probability information in warnings is given in the NSTC Report, Chapter 5, page 21:

“Probabilities are being given more and more frequently to specify the likelihood of an event occurring or the certainty of the forecast. The public is learning how to use this information. Increasingly, probabilities can be determined by specific computer models. For example, the US NWS issues probabilities of where an approaching hurricane will strike the coast. The NWS expects to incorporate probability data in other information as the state of the science allows, including other warning events and varying amounts of liquid or frozen precipitation.”

An example from the UK Met Office is given on page 7.

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