



Skywarn Service Guide



Macomb County ARPSC
Macomb County, MI USA

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Introduction and Contents

Introduction

The Macomb County Amateur Radio Public Service Corps ARES / RACES (Amateur Radio Emergency Services / Radio Amateur Civil Emergency Services) organization—or Macomb County ARPSC—has developed this guide to:

- Ensure a common understanding of its Skywarn activities among members and served agency stakeholders
- Provide members with guidance on running the Skywarn service and performing operational activities
- Ensure alignment between served agency needs and Skywarn activities
- Improve the quality of service delivery by providing participating amateurs with a consistent, uniform method of performing activities and of measuring performance

Purpose of Skywarn Service

The Macomb County ARPSC recognizes that the National Weather Service (NWS) has a need for more information regarding severe local storms, and that observations from trained weather spotters can be a valuable source of such information. To this end, the ARPSC has developed this volunteer Skywarn Service to collect reports from spotters in Macomb County and relay that information directly or indirectly to the NWS.

Level of Service

Members of ARPSC will provide this volunteer service in accordance with the guidance in this document on a “best effort” basis, exemplifying the public service tradition of amateur radio.

While Macomb County ARPSC will always strive for a high-level of quality, it provides no guarantees or other assurance to the served agencies or the public that these guidelines will always be followed, or that severe weather elements will be accurately and/or completely reported. Information provided by this service should be considered a supplement to other primary weather observation and forecasting services and technologies.

Contents

This guide contains the following components:

- **Section 1: The Served Agency** describes the National Weather Service's needs for Skywarn spotter information.
 - **Section 2: Resources** describes the people and technology needed to satisfy the served agency's needs.
 - **Section 3: Procedures** contains the administrative and operating procedures that are followed by the spotters and other Skywarn participants to satisfy the served agency's needs.
 - **Appendix A: Skywarn Net Work Instructions and Checklist** contains the checklist that is utilized by the net control station (NCS) operator to manage a Skywarn net.
 - **Appendix B: Technical Resources** lists the various technical information (e.g., frequencies) needed when operating the technology resources.
 - **Appendix C: Skills and Training Standard** lists training knowledge and skill elements for Skywarn net participants, and maps those elements to training resources.
 - **Appendix D: Metrics Standard** contains guidelines for measuring the performance of the Skywarn program.
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Change Record

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Section 1: The Served Agency

Introduction

The Macomb County ARPSC maintains this Skywarn service to provide the National Weather Service (NWS) with timely reports of severe weather elements, primarily during tornado watches and severe thunderstorm watches. This section describes NWS needs and how those needs can be addressed by a Skywarn service.

Description of Agency

The National Weather Service is an organization within the National Oceanic and Atmospheric Administration (NOAA), which is part of the US Department of Commerce. The NWS provides a number of services to the public, including the issuance of watches and warnings for tornadoes and severe thunderstorms.

The Detroit/Pontiac Forecast Office, located in White Lake, Michigan, is the NWS office that issues watches and warnings for Macomb County, and other counties within southeast lower Michigan.

The Michigan Inter County Organizational Network (MICON) is an amateur radio organization that also serves the NWS. Its primary mission is to relay information between the Detroit/Pontiac Forecast Office and the Skywarn nets in each of the counties served by the forecast office. It does so by utilizing a number of amateur radio technologies, further described in the technical resources section, below.

Agency Needs

To provide public severe weather warnings, the NWS depends partially on a variety of forecast and observation technologies, including NEXRAD Doppler RADAR. None of these technologies, however, is capable of providing the NWS with current, local reports of severe weather elements, such as high-winds, hail, flooding, and tornadoes. For this information, the NWS relies on reports supplied by trained weather spotters. These spotters, coupled with the weather technologies, provide the complete picture needed by the NWS to provide accurate warnings.

Service Requirements

To meet the needs of the served agency, this service must satisfy the following requirements:

- Accurately and safely identify (“spot”) severe weather elements when they occur anywhere within Macomb County.
 - Relay severe weather observations to the NWS, generally through MICON.
 - Be prepared to operate whenever severe weather occurs or threatens.
 - Maintain operation in spite of storm elements, such as high winds and lightning, which can cause equipment and power failures.
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Service Solution

“Skywarn” is the name given to teams of trained weather spotters (many of whom are amateur radio operators) who volunteer their time to observe and report severe weather.

To meet the NWS needs, the Macomb County ARPSC operates a Skywarn service, which includes the people, process, and technology components needed to gather information from the spotters and relay that information to the NWS.

Section 2: Resources

People Resources

Introduction

An effective Skywarn program is enabled primarily by the accurate observations, information collection, and information reporting activities of skilled net control station operators and trained severe weather spotters. This section details the roles and responsibilities, training requirements, and manpower requirements for the people component of the Skywarn program.

Roles and Responsibilities

Administration

NWS Liaisons – The NWS liaisons are responsible for the management of the Skywarn Service, as described within this guide.

Emergency Coordinator – The emergency coordinator is responsible for providing oversight to the NWS liaisons, and is ultimately responsible for meeting the needs of the served agencies.

Skywarn Operations

Net Control Station – The net control station (NCS) operator is responsible for the end-to-end operation of a Skywarn net, including:

- Determining when to initiate and terminate a net
- Establishing net conditions (green, red, etc.)
- Accepting check-ins
- Managing traffic on the tactical, directed Skywarn net
- Ensuring that the other operational roles are covered

MICON Key Station – The MICON key station operator is responsible for checking into the MICON net, and for relaying information between the MICON NCS and the Skywarn NCS.

EMWIN Resource – If needed during a net, the EMWIN (Emergency Managers Weather Information Network) resource is responsible for obtaining relaying current NWS watch and warning data to Net Control.

Spotters – Spotters check into the Skywarn net and provide reports of weather elements to Net Control.

**Knowledge, Skills
and Training**

To function in an operational role, amateur radio operators require certain specialized knowledge and skills. Appendix C contains a summary of the required knowledge and skills for operators in NCS, EMWIN resource, MICON liaison, and spotter roles. Appendix C also contains a map of the knowledge and skills to formal and informal training.

Appendix C references the following training:

- National Weather Service Spotter Training (Combined Basic and Advanced)
- FEMA Independent Study Course IS-2
- An annual briefing held for NCS operators, EMWIN resources, and MICON liaisons by the NWS liaisons

To ensure operators remain current with NWS spotting and Skywarn operational procedures, the NWS Spotter Training course must be repeated every two years.

New NCS operators must also operate a Skywarn net under the supervision of a NWS liaison, including taking check-ins for at least 1.5 hours, to demonstrate their procedural knowledge and operational skills.

NCS operators who serve as MICON key stations must be briefed by an NWS liaison on key station operating practices and procedures, and must be familiar with the current MICON procedure manual.

When an urgent need arises, any radio amateur who is a member of the Macomb County ARPSC, and who is current with all baseline training required for membership may serve in any of the operational roles.

Manpower

Based on current experience:

- Approximately twenty one trained amateur radio spotters are required to conduct a Macomb County Skywarn net during a typical severe weather event. Assuming that only twenty-five percent of the total number of trained amateurs are available to participate at any given time, a pool of at least 84 amateur radio spotters must be maintained.
 - A pool of six trained Skywarn NCS operators must be maintained. At least one-half, but preferably all of these operators must also be trained to serve as MICON key (or liaison) stations and EMWIN resources.
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Technical Resources

Introduction

To address the Skywarn service requirements and ultimately meet the needs of the served agency, the Macomb County ARPSC Skywarn Service must utilize a number of technologies for obtaining NWS communications and submitting weather reports. These technologies are used in support of the following functions:

- Net Control Communications
- Spotter Communications
- County-Wide Distance Communications
- MICON Liaison
- Weather Information

The remainder of this section describes the requirements and technical solution for each of these functional areas.

Net Control Communications Support

Requirements - The NCS must be capable of maintaining control over the directed, tactical net for the duration of the severe weather event. The communication equipment must therefore be reliable, be resistant to failure due to power interruptions and lightning strikes, and be capable of performing on an extended duty cycle.

Solution – The NCS operator must utilize a good quality mobile or fixed 2M station with appropriate lightning protection and an emergency backup power feature. A backup radio is desirable but not required.

Spotter Communications Support

Requirements – Skywarn spotters must be able to operate from tactical locations that allow them to safely observe the sky and to move to a place of safety if weather becomes threatening. Equipment should be protected from lightning strikes for the safety of the operator and prevention of equipment damage. Because spotters are usually deployed in a manner that permits multiple spotters to observe the same weather conditions, protection from power and equipment failure is desirable but not essential.

Solution – Spotters must utilize reliable portable, mobile, or fixed 2M station equipment with appropriate lightning protection. Emergency backup power is desirable but not required.

**County-Wide
Distance
Communications
Support**

Requirements – The NCS, spotters, and MICON key station may be located on opposite sides of the county, and the tactical locations of the spotters may require them to use low-power portable or mobile radios. The net, therefore, requires the support of a radio repeater.

To address the requirement for communication resiliency, the repeater must have a standby power feature in the event a storm causes utility power to fail. Because a repeater is subject to damage from lightning strikes, an alternate repeater is also needed.

Solution - Macomb County ARPSC will utilize its own 2M repeater, which is connected to an automated standby generator. ARPSC has also made arrangements with both the USECA (Utica Shelby Emergency Communication Association) LCARC (L'Anse Creuse Amateur Radio Club) organizations to utilize their 2M repeaters in the event the ARPSC repeater fails.

**MICON Key Station
Support**

Requirements – Because all severe weather reports must pass through the MICON key (liaison) station, the key station must meet the same quality and resiliency requirements listed for the NCS, above. The key station must also be able to communicate with both the Skywarn net and MICON, preferably at the same time.

MICON receives severe weather reports on behalf of the NWS via the following:

- Tactical net on 70cm
- Packet to TNC bulletin board on 2M
- Telephone
- Internet-based eSpotter web site (low priority messages)

Solution – The MICON key station operator must utilize at least one good quality station with emergency power backup and lightning protection features. If the 70cm MICON net will be used to relay information, then the station antenna must be placed at a sufficient height, and must have sufficient gain, to reach the Milford repeater.

As an alternative to 70cm RF, the key station may utilize the EchoLink computer program to connect to the MICON repeater over the Internet. Use of this program requires a broadband or DSL Internet connection, and a computer that meets the EchoLink hardware requirements.

**Weather
Information
Support**

Requirements – The NCS requires up-to-date NWS watch and warning information in order to determine current net conditions (e.g., Green, Yellow, etc), and plan for future net condition changes. Spotters require up-to-date information in order to help determine what to look for and when to move to shelter. Information to support the above is available through several NWS sources, including MICON (via the liaison), Emergency Manager’s Weather Information Network (EMWIN) feeds, and NOAA weather radio.

EMWIN data feeds are available through satellite, the Internet, and FM subcarrier (SCA) broadcast. They can be received with a computer running EMWIN software, which is then connected directly to the Internet, or to satellite / subcarrier FM receiving and decoding equipment.

MICON initiates a spotter activation request by sending out numeric pages. These pages are sent to NWS liaisons and ECs from each county who appear on their paging list. Weather status information is disseminated over the MICON 70cm tactical net.

While ARPSC personnel are typically not trained to read weather radar, WSR-88D (NEXRAD Doppler radar) images provided by the NWS can be a useful adjunct to NWS weather information when making decisions regarding net status. Up-to-date images that show reflectivity caused by precipitation are available on the NWS website.

Solution – To monitor NWS watch and warning status, the NCS or EMWIN resource should utilize at least a NOAA weather radio, although a computer connected to an EMWIN feed (with weather radio backup) is preferred. Ideally, the EMWIN feed should utilize the SCA or satellite delivery methods, which are less susceptible to weather-induced outages than broadband or DSL Internet feeds.

The NWS liaisons and EC should have the ability to receive numeric pages from MICON, using either a numeric pager or cell phone with a numeric paging capability.

The EMWIN resource or NCS should utilize a computer with access to the Internet to view WSR-88D images.

Section 3: Procedures

Skywarn Service Administration

Introduction

The procedures in this Skywarn Service Administration section describe the actions needed to maintain a working Skywarn program in Macomb County. It contains the following subsections:

- NWS / MICON Relationships – Interacting with served agency representatives
 - People Resources – Ensuring that operators are available for staffing Skywarn nets
 - Training – Providing training to the people resources
 - Service Guide – Maintaining this document
 - Process Improvement – Ensuring processes, procedures, and checklists reflect the current needs
 - Metrics – Measuring the success of this service
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NWS / MICON Relationships

The NWS liaisons will attend biannual MICON meetings and maintain relationships with designated NWS and MICON contacts for the purposes of:

- Receiving new direction, including procedure and technology changes
- Receiving any other relevant information
- Communicating Macomb County Skywarn service readiness and other status information
- Contributing to the overall improvement of NWS Detroit-Pontiac Skywarn operations

As appropriate, the liaisons will:

- Communicate news and Skywarn service developments to the ARPSC membership
 - Submit Skywarn Service Guide change requests to ensure alignment between the county service and the NWS Detroit-Pontiac Skywarn program
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People Resources

The NWS liaisons will monitor the available pool of trained amateur radio spotters and Skywarn NCS operators to ensure that its number remains above the number specified under “Manpower” in “People Resources,” above.

The NWS liaisons will publish an NCS schedule which, on a weekly basis, indicates which of the NCS Skywarn operators from the pool of qualified operators will be responsible for initiating a Skywarn net if conditions warrant. The schedule will contain a primary NCS operator, a secondary NCS operator, and the name of one of the NWS liaisons who will provide oversight.

Training

The NWS liaisons will ensure NWS Skywarn courses are made available in Macomb County for persons in the area—particularly amateurs—who are interested in receiving Skywarn training:

- In January of each year, the NWS liaisons will work with the NWS to schedule approximately three Skywarn classes in Macomb County. The classes should be targeted for no earlier than March, and no later than May.
 - The NWS liaisons must provide class locations and resources such as projector screens. Locations may be arranged through the Macomb County Office of Emergency Management.
 - At least one class should be held on a Saturday morning and one class on a weekday evening.
- After the classes have been scheduled, the NWS liaisons will publicize the availability of the Macomb County classes, and other local classes open to ARPSC members, as follows:
 - Provide notice of the classes at ARPSC meetings and every other weekly net
 - Request that the ARPSC administrative coordinator and webmaster publish notices in the newsletters and websites, respectively
 - Send an email or other notification to contacts at USECA and other Macomb County amateur radio clubs
- One or more NWS liaisons, the EC, or another ARPSC representative must be present at each class location to ensure facility access, arrange seating and resources, welcome the NWS instructor, and ensure the facility is restored to an acceptable condition at the end of the class.

The NWS liaisons will also ensure that the class location is restored to its pre-class condition prior to departure.

Service Guide

The NWS liaisons will maintain the Skywarn Service Guide, as described below.

- The NWS liaisons will manage document changes, as follows:
 - Receive and review change requests from other ARPSC members
 - Create periodic draft (“redline”) versions of the Guide for member review, comment, and consensus approval
 - Publish revised production versions of the Guide containing approved changes
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Process Improvement

The NWS liaisons, EC, and other participants in the Skywarn program will continuously seek opportunities to improve the Macomb County Skywarn service, and will communicate those opportunities to the NWS liaisons in the form of Service Guide change requests. The NWS liaisons will work with members who submit change requests to ensure that the members' ideas for improvement are properly documented in those requests.

Metrics

The NWS liaisons will generate metrics on readiness, service, and quality in accordance with the Metrics Standard in Appendix D. They will then:

- Publish or otherwise communicate the metrics to ARPSC membership
- Utilize the metrics to identify deficiencies in the Skywarn Service performance and determine methods for performance improvement
- Utilize the metrics to measure Skywarn Service improvements

Reporting

The NWS liaisons will perform a quality review of Skywarn net checklists submitted by NCS operators.

After review, the NWS liaisons will:

- Submit the checklists to the Macomb County ARPSC Administrator in a format acceptable to that administrator, as determined annually.
 - Retain a copy of each checklist until February 1 of the following year.
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Skywarn Operations – Net Control Station

Introduction

This section of the operations guidelines applies to net control station operation. On any given day, an NWS liaison, a primary NCS operator, and a backup NCS operator will be assigned NCS responsibilities on the duty roster. This group of operators is collectively called the NCS team throughout this section.

This section contains the following topics:

- General Responsibilities – Working together to ensure nets are initiated when needed
- Awareness – Staying alert to weather conditions
- Notification – Being notified of a severe weather event
- NCS Assignment – Assuming net control station responsibilities
- Net Initiation – Starting a net at the appropriate time
- NWS Watches and Warnings – Tracking severe weather watches and warnings
- Net Conditions and Preambles – Using the appropriate scripts
- Station Check-ins – Checking in spotters and other stations
- Element Logging and Reporting – Receiving, logging, and passing spotter reports
- Emergency Traffic – Ensuring emergency traffic has precedence
- MICON Liaison – Working with a MICON liaison
- EMWIN Information Resource – Working with an EMWIN resource
- Net Termination – Closing the net

General Responsibilities

The NCS team is responsible for monitoring the weather, and for initiating a Skywarn net should such a net be warranted by the weather conditions. Responsibility for initiating a net falls first on the primary NCS operator, then on the secondary NCS operator, and finally on the NWS liaison. All members of the team, however, should work together to ensure NCS coverage throughout the day.

NCS operators who know they will be unavailable during their scheduled time should notify the NWS liaison.

Awareness

On a continuous basis, NCS team members will maintain a general awareness of the weather conditions, in order to:

- Know whether to anticipate a severe weather event
- Plan their availability to initiate a net

This guideline can be met by:

- Reading the current NWS severe weather outlook on the Internet web site, or listening to it on NOAA weather radio, several times during the day
 - Checking the NWS Storm Prediction Center forecast products on the Internet web site several times during the day
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Notification

The NCS team will be notified of a severe weather event through one or more of the following:

- A page sent by MICON to the NWS liaisons
- A tornado or severe thunderstorm watch issued by the NWS for Macomb County over EMWIN and NOAA Weather Radio
- A tornado or severe thunderstorm warning issued by the NWS for Macomb, Oakland, Wayne, Lapeer, and/or St. Clair counties

If the on-duty NWS liaison receives a MICON page, the liaison will communicate the information received to the primary NCS operator.

Upon notification of a severe weather event, all NCS team members will begin monitoring the Macomb County ARPSC repeater frequency.

NCS Assignment

Upon notification of a weather event, the primary NCS operator on the NCS team will contact the on-duty NWS liaison to indicate that he or she has assumed responsibility for the net.

The primary NCS operator must coordinate initial NCS responsibilities with the liaison and backup operator in the event that the primary operator is not able to initiate a net.

Net Initiation

The decision to initiate a net is the responsibility of the primary NCS operator, or whomever he or she has designated.

The NCS operator will initiate a Skywarn net whenever the operator believes a net is warranted, using the Net Conditions Criteria in the Checklist (Appendix A) as a guide.

All Skywarn nets will be operated as directed, tactical nets.

When the NCS operator initiates a net, he or she will begin using the current version of the Skywarn Net Work Instructions and Checklist. The operator will then log-in to the checklist as Net Control in the Participating Stations section.

NWS Watches and Warnings

Upon initiating a net, the NCS operator will begin logging National Weather Service watches and warnings in Macomb County and counties adjacent to Macomb County, using the appropriate section of the Checklist. The NCS operator will use this information as an aid to determining net conditions.

Net Conditions and Preambles

Whenever the NCS operator initiates a net or changes a net condition, the NCS operator will read the appropriate NCS preamble listed in the Checklist. The operator will then note the net condition in the appropriate section of the Checklist, along with the reason for establishing that condition and the current time.

Net Control will make an announcement reminding spotters of the net condition, in accordance with the following:

- Standby – Approximately every 15 minutes, as needed
- Condition Green – Every 10 minutes
- Conditions Yellow or Red – Every 5 minutes, traffic permitting

From time-to-time, Net Control will remind spotters of the types of reports (elements) accepted during the net condition.

Station Check-Ins

While the Skywarn net is in condition green, Net Control will accept check-ins from participating spotter stations, and will log each station in the appropriate section of the Checklist. In the log, the NCS operator will note whether the station is a spotter and/or is working as MICON liaison or EMWIN resource, the station identifier, the station location (given as a major cross street intersection), and the time in.

When a station checks out from the net, the NCS operator will note the checkout time on the Checklist.

If a station changes a role, such as from spotter to NCS, the station will be logged-out under the old role, and logged back in under the new role.

If a station provides a report but is not checked-in, Net Control will automatically check-in that station, using the time of the report as the check-in time.

Element Logging and Reporting

Net Control will only accept reports from trained Skywarn spotters.

Net Control will only accept reports of elements that are consistent with the current net condition, as described in the Checklist.

The NCS operator will log all reports in the appropriate section of the Checklist, using the “time – effect – location” format. Locations will be logged as major cross street intersections.

Upon receipt of a report, the Net Control will ensure that the report is transmitted to MICON at the earliest possible opportunity. Reports of funnel clouds and tornadoes will be given the highest precedence. Options for transmitting the information include:

- Direct reporting through the MICON net or NWS land line by the NCS operator
- Relaying through the MICON liaison on the net
- Entry into the eSpotter web site (for low priority reports only)

Upon transmission of the report to MICON, the NCS operator will indicate on the Checklist how the report was transmitted.

Emergency Traffic

While in operation, Net Control will give precedence to emergency traffic from any station, as defined below:

- **Emergency traffic** involves messages intended to save lives, prevent injury, and protect property. Examples of emergency traffic include requests for assistance due to traffic accidents with injuries, building fires, and hazardous material releases.

If a tornado warning has not been issued, reports of funnel clouds and tornadoes are considered emergency traffic.

- **Priority traffic** involves spotter reports and other communications relating to the Skywarn net, *including reports of funnel clouds and tornadoes if impacted counties are already under a tornado warning.*
 - **Welfare traffic** and **routine traffic** are not handled during Skywarn nets.
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MICON Liaison

If, during the check-in process, an operator volunteers to serve as a MICON liaison, Net Control should accept the offer if it is made by a qualified operator.

When leveraging a MICON liaison station, Net Control must continue to log all spotter reports, as described above. The NCS operator should indicate how a report was relayed to the NWS by placing a check in the appropriate box, but only after receiving confirmation from the liaison operator that the traffic has been passed to MICON.

EMWIN Resource

If, during the check-in process, an operator volunteers to serve as an EMWIN (Emergency Managers Weather Information Network) resource, Net Control may accept the offer if the NCS operator believes workload warrants delegation of this function.

Information received from the EMWIN resource should be logged under the NWS watches and warnings section on the log form.

The NCS operator may choose to consult with the EMWIN resource prior to changing the net status. This consultation may be particularly useful if the EMWIN resource has access to recent NEXRAD images.

Net Termination

The NCS operator should terminate the net when an “All Clear” message has been received from MICON, or when Macomb County is no longer under the threat of severe weather (i.e., items 1 – 9 in the Net Conditions table in the Checklist can be answered “No”).

Upon termination of the net, the NCS operator will:

- If the net is being closed from conditions yellow or red, obtain check-ins from any remaining stations that have not checked-in..
 - Make an announcement that the net has been terminated, and that the repeater has been restored to normal use.
 - Indicate that the net has been closed in the Net Condition section of the Checklist.
 - Log out all participating stations on the Checklist.
 - Review the checklist to ensure that it is complete and correct.
 - Submit the completed checklist to an NCS Liaison within 3 days.
 - Checklists may be submitted by mail as a paper copy, by email in MS-Word or TIFF (scanned) format.
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Skywarn Operations – Spotter

Introduction

This section of the operations guidelines applies to spotter operation. It contains the following topics:

- Safety – Steps that a spotter should take to ensure lives are not endangered by the spotting activity
- Awareness – How a spotter should become aware of a severe weather event
- Notification – How a spotter will be notified that a net has been established
- Check In – Guidelines for checking into a Skywarn net
- Reporting – Guidelines for reporting severe weather elements
- Check Out – Guidelines for checking out of a Skywarn net

The NCS station operator may also submit spotter reports.

Safety

Prior to performing any other spotter activities, spotters must continuously ensure the following:

1. That they do not pose an impediment or hazard to vehicles or pedestrians, and that moving vehicles do not pose a hazard to their person
2. That they are protected from lightning strikes, such as by operating from within a building or a vehicle having a metal roof
3. That they may immediately access a place of safety for personal protection from high winds, flying debris, hail, and lightning

When operating from a motor vehicle, spotters must also continuously ensure that they have a means of escape via roads that run at right angles to the approaching storm.

Awareness

On a continuous basis, spotters should ensure that they will be notified of a tornado or severe thunderstorm watch within 1 hour of dissemination by the NWS. (This guideline can be satisfied by monitoring radio/TV media or NOAA Weather Radio, subscribing to email or pager notifications, etc.)

Whenever possible, spotters should also monitor weather information sources for information on approaching severe weather, in the event that severe weather occurs and no watch has been issued.

Notification

Upon becoming aware of a tornado or severe thunderstorm watch, or approaching severe weather, spotters should monitor the primary net frequency (and backup frequencies, if possible).

Spotters will be notified that a Skywarn net has been started when they hear the NCS announce a net condition.

Check In

Upon notification that a net has been started, spotters will follow the directions issued by the NCS.

When spotters are available for spotting, and when the net is in condition green, they will check into the net.

When checking into the net, spotters will provide their location as the nearest major cross street intersection (e.g., “M-59 & Mound”).

Reporting

After checking into a Skywarn net, spotters will monitor the environment for severe weather elements, and report newly spotted elements to the NCS.

Spotters will only provide reports of elements consistent with the net condition, as described during training and announced by Net Control.

Spotters will provide reports in the “T-E-L” format by supplying the following information, in the order listed:

- The time of the observation
- The weather effect (or element) observed
- The location of the effect, in terms of a major cross street intersection (e.g., “23 Mile and Romeo Plank”)

When reporting tornadoes, funnel clouds, or wall clouds, spotters will also provide the estimated direction (e.g., E, SE, ESE, etc.) and speed of movement.

Check Out

Spotters who leave the net prior to closing should check out with the NCS.

All remaining spotters are automatically checked-out upon termination of the net.

Skywarn Operations – MICON Key (Liaison) Station

Introduction

Information received from spotters must be relayed to the NWS through MICON or through the eSpotter web site. This function may be performed by Net Control, or by a MICON key (or liaison) station, which is the subject of this section.

This section outlines how an operator is assigned MICON key station duties and how those duties are performed. It also describes the criticality of the role, and provides guidelines for ceasing operation.

Check-in and Assignment

Upon checking in with the NCS, an operator who has continuous and reliable access to both MICON and the Skywarn net may offer his or her services as a MICON key station.

The key station will become operational if and when the NCS accepts the operator's offer.

Upon becoming operational, the key station will establish communications with MICON, and will report that communications have been established to Net Control.

Key Station Activities

The key station operator should use standard tactical practices to accurately communicate traffic from MICON to NCS and vice-versa, being careful to give precedence to emergency traffic.

The operator should use the Weather Element log from the Checklist to log spotter reports, and the NWS Watches and Warnings log when this type of traffic is received from MICON for passing to the NCS.

The operator should monitor and log spotter reports as they are provided to the NCS so that the NCS will not need to repeat the information.

Criticality of Role and Termination of Operation

The MICON key station operator is potentially a single point of failure in communication of traffic to the served agency (the NWS), and must therefore take steps to prevent or mitigate a coverage break.

The key station operator must receive approval from the NCS prior to taking a break or terminating operation; such approval should only be requested during Standby or Green conditions.

Upon equipment failure, or when moving to safety due to proximity to severe weather, the operator must make every effort to notify the NCS. The operator should keep a backup radio or cellphone handy for this purpose.

Key station operation may be terminated at the request of the NCS, or upon termination of the net.

Skywarn Operations – EMWIN Resource

Introduction

In order to assist with establishing the appropriate net condition, and to provide weather updates to spotters, the NCS requires access to current NWS information. This information includes not only watches and warnings, but storm speed and direction, areas impacted, and anticipated duration of the net. For details on possible information sources, refer to the Weather Information Support subsection under Technical Resources, above. The source of choice, however, continues to be a NWS Emergency Managers Weather Information Network (EMWIN) feed via satellite, Internet, or FM SCA.

A Skywarn NCS operator may not always be positioned to have access to the weather information described above. During busy nets, the NCS may not have the time to check the information sources. For both of these reasons, the NCS may designate an EMWIN resource to monitor information sources and keep the NCS apprised of developments.

This section outlines how an operator is assigned EMWIN resources duties and how those duties are performed. It also provides guidelines for ceasing operation.

Check In and Assignment

Upon checking in with the NCS, an operator who has continuous and reliable access to current EMWIN and the Skywarn net may offer to serve as an EMWIN resource.

The EMWIN resource will become operational if and when the NCS accepts the operator's offer.

EMWIN Resource Activities

The EMWIN resource should monitor NWS information sources, and provide updates to the NCS when requested to do so.

The EMWIN resource should notify the NCS of watch and warning status changes for Macomb County, and other counties from which storms are entering Macomb County.


The EMWIN resource will ensure that he or she gives precedence to emergency traffic.

Criticality of Role and Termination of Operation

The EMWIN resource station must receive approval from the NCS prior to taking a break or terminating operation; such approval should only be requested during standby or green conditions.

Upon equipment failure, or when moving to safety due to proximity to severe weather, the resource station must make every effort to notify the NCS. The resource station should keep a backup radio or cellphone handy for this purpose.

Resource station operation may be terminated at the request of the NCS, or upon termination of the net.

 <p>Skywarn Net Work Instructions and Checklist</p> <p>All times are local.</p>	Primary	147.200 MHz+ 100 Hz PL (Input: 147.800 MHz)
	Backup	147.180 MHz+ 100 Hz PL (Input: 147.780 MHz)
	MICON-DTX	442.150 MHz+ 100 Hz PL (Input: 447.150 MHz)
	MICON LL	Spotter Line – 1-800-808-0006

NWS Watches and Warnings

page ____ of ____

Log each watch issued by the NWS for Macomb County.

Log each warning issued by the NWS for Macomb County, and the counties of Wayne, Oakland, Lapeer and St. Clair.

TRW = Thunderstorm

TDO = Tornado

Watch	Warning	County	Start	End
<input type="checkbox"/> TRW <input type="checkbox"/> TDO	<input type="checkbox"/> TRW <input type="checkbox"/> TDO			
<input type="checkbox"/> TRW <input type="checkbox"/> TDO	<input type="checkbox"/> TRW <input type="checkbox"/> TDO			
<input type="checkbox"/> TRW <input type="checkbox"/> TDO	<input type="checkbox"/> TRW <input type="checkbox"/> TDO			
<input type="checkbox"/> TRW <input type="checkbox"/> TDO	<input type="checkbox"/> TRW <input type="checkbox"/> TDO			
<input type="checkbox"/> TRW <input type="checkbox"/> TDO	<input type="checkbox"/> TRW <input type="checkbox"/> TDO			
<input type="checkbox"/> TRW <input type="checkbox"/> TDO	<input type="checkbox"/> TRW <input type="checkbox"/> TDO			
<input type="checkbox"/> TRW <input type="checkbox"/> TDO	<input type="checkbox"/> TRW <input type="checkbox"/> TDO			

Net Condition

Log each change in net condition (Standby, Green, Yellow, Red). The final entry should be "Close."

When the net condition changes, read the appropriate preamble from the preambles and scripts.

Prior to closing the net from a yellow or red condition, take any remaining check-ins.

Provide a net status update every 10 minutes during condition green, and every 5 minutes (traffic permitting) during yellow and red.

Condition	Reason	Time
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		
<input type="checkbox"/> S <input type="checkbox"/> G <input type="checkbox"/> Y <input type="checkbox"/> R <input type="checkbox"/> Close		

Participating Stations

page ____ of ____

Log each participating station, including the operator's role as **Spotter**, **MICON** liaison, **EMWIN** resource, or **NCS**. Ensure that each station is logged in and out; if a station does not check out, log out that station at the end of the net. Log yourself in as soon as you begin monitoring the weather in a standby condition, even if you are not yet taking check-ins.

If a station changes a role (e.g., spotter to net control, MICON liaison to spotter), log that station out and create a new entry with the station's new role.

Begin check-ins from the area likely to be impacted first.

Accept check-ins from certified Skywarn spotters only, but accept emergency traffic from any station.

Accept check-ins only during standby or green conditions, and prior to close down. Also check-in any certified stations not checked-in, but providing a report.

Emergency traffic involves messages intended to save lives, prevent injury, and protect property.

If a tornado warning has not been issued, reports of funnel clouds and tornadoes are considered emergency traffic.

Role	Station	Location	In	Out
<input type="checkbox"/> S <input type="checkbox"/> MICON <input type="checkbox"/> EMWIN <input type="checkbox"/> NCS				
<input type="checkbox"/> S <input type="checkbox"/> MICON <input type="checkbox"/> EMWIN <input type="checkbox"/> NCS				
<input type="checkbox"/> S <input type="checkbox"/> MICON <input type="checkbox"/> EMWIN <input type="checkbox"/> NCS				
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<input type="checkbox"/> S <input type="checkbox"/> MICON <input type="checkbox"/> EMWIN <input type="checkbox"/> NCS				
<input type="checkbox"/> S <input type="checkbox"/> MICON <input type="checkbox"/> EMWIN <input type="checkbox"/> NCS				

Weather Reports

Log **every** report below (even those that are inappropriate), using the T-E-L (time-effect-location) format.

When the report has been passed to the NWS, note how the information was passed by checking the appropriate box (MICON **Net**, MICON packet (**Pkt**), land line (**LL**), or the **eSpotter** web page).

Green

- Gust front arrival
- Approaching thunderstorms
- Torrential rain (near 0 visibility)
- Other severe events

Yellow

- Intense, frequent lightning (frequency)
- Hail (give diameter)
- Damaging winds (speed, direction, damage, if any)
- Heavy / torrential rains (water over curbs)
- Wall clouds (direction, speed, rotation?)
- Funnel clouds (direction, speed, rotation?)
- Tornadoes (direction, speed, visible damage?)

Red

- Wall clouds (direction, speed, rotation?)
- Funnel clouds (direction, speed, rotation?)
- Tornadoes (direction, speed, visible damage?)

Station	Time	Effect	Location	Passed Via
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
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				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot
				<input type="checkbox"/> Net <input type="checkbox"/> Pkt <input type="checkbox"/> LL <input type="checkbox"/> eSpot

Net Control Preamble and Scripts

<p>Standby <i>(About every 15 minutes, as needed)</i></p>	<p>This is <your call sign>, Net Control for Macomb County Skywarn. The net is (now) in <u>standby</u>, and routine traffic is permitted. The net condition will be upgraded if conditions warrant.</p> <p><i>If applicable and as-needed: The National Weather Service has issued a <severe thunderstorm / tornado> <watch / warning> for <area> until <time>. Provide additional information from bulletin, as needed.</i></p> <p>This is <your call sign>.</p>
<p>Net Opening <i>(Once)</i></p>	<p>This is <your call sign>, Net Control for Macomb County Skywarn. This net is now in condition <u>green</u>.</p> <p><i>If applicable: The National Weather Service has issued a <severe thunderstorm / tornado> <watch / warning> for <area> until <time>.</i></p> <p>The purpose of this Skywarn net is to provide the National Weather Service with reports of severe weather conditions.</p> <p>This is a directed, tactical net, and only communication with Net Control is permitted. Only licensed amateur radio operators in Macomb County, certified with Skywarn training may check into this net. However, stations with emergency traffic, regardless of operator training, will be given precedence by Net Control.</p> <p><i>Break.</i></p> <p>When checking-in to the net, please give your call sign phonetically, and state your location as a major intersection. If not acknowledged by Net Control, please recheck.</p> <p><i>Standard phrase: We will now accept check-ins from <M-59 north to the county line / 14 Mile north to M-59 / 8 Mile north to 14 mile>. Then: Net Control recognizes: List call signs and locations. Continue with check-ins as needed: Are there any additional check-ins from <location>? Listen for stations breaking with emergency traffic.</i></p> <p><i>Break, then continue with Green section, below.</i></p>
<p>Green <i>(Every 10 Minutes)</i></p>	<p>This is Net Control for Macomb County Skywarn. This net is (now) in condition <u>green</u>.</p> <p><i>If applicable: The National Weather Service has issued a <severe thunderstorm / tornado> <watch / warning> for <area> until <time>.</i></p> <p>Net Control is accepting check-ins, as well as reports of all types of severe weather effects.</p> <p><i>As needed: Reportable effects include <read Green list from Weather Reports Log>.</i></p> <p><i>As needed: Please keep all reports brief and concise, using the Time, Effect, and Location format.</i></p> <p>This is <your call sign>.</p>

<p>Yellow</p> <p><i>(Every 5 Minutes, Traffic Permitting)</i></p>	<p>This is Net Control for Macomb County Skywarn. This net is (now) in condition <u>yellow</u>.</p> <p><i>If applicable and as needed: The National Weather Service has issued a <severe thunderstorm / tornado> <watch / warning> for <area> until <time>.</i></p> <p><i>As needed: This is a directed, tactical net, and only communication with net control is permitted.</i></p> <p><i>As needed: Net Control is not accepting check-ins, and is only accepting reports of the following effects <read Red and Yellow effect lists from Weather Reports Log>.</i></p> <p><i>As needed: Please keep all reports brief and concise, using the T-E-L (Time, Effect, and Location) format.</i></p> <p>This is <your call sign>.</p>
<p>Red</p> <p><i>(Every 5 Minutes, Traffic Permitting)</i></p>	<p>This is Net Control for Macomb County Skywarn. This net is (now) in condition <u>red</u>.</p> <p><i>If applicable and as needed: The National Weather Service has issued a <severe thunderstorm / tornado> <watch / warning> for <area> until <time>.</i></p> <p><i>As needed: This is a directed, tactical net, and only communication with net control is permitted.</i></p> <p><i>As needed: Net Control is not accepting check-ins, and is only accepting reports of the following effects <read Red list from Weather Reports Log>.</i></p> <p><i>As needed: Please keep all reports brief and concise, using the Time, Effect, and Location format.</i></p> <p>This is <your call sign>.</p>
<p>Close Down</p>	<p>This is Net Control for Macomb County Skywarn. Severe weather is no longer threatening Macomb County, and this net is being terminated.</p> <p><i>If terminating from conditions Red or Yellow: Net Control will now accept check-ins from any station that has not had an opportunity to do so. Receive and list check-ins.</i></p> <p><i>If applicable: A tornado watch / severe thunderstorm watch remains in effect for <area> until <time>. Net Control will start another Skywarn net at a later time if conditions warrant.</i></p> <p>On behalf of the Macomb County Amateur Radio Public Service Corps, Net Control thanks all radio amateurs who have participated in today's Skywarn net. The net is now terminated, and this frequency is being returned to normal use.</p> <p>This is <your call sign>.</p>

Net Condition Criteria

These criteria provide guidance for the Skywarn NCS when establishing net conditions. There are two major goals:

- Prevent check-ins and lower priority reports, such as those providing rainfall amounts, from interfering with higher priority reports, such as those involving damaging winds or tornadoes.
- Permit as many spotters to check-in as possible.

The Skywarn NCS may establish net conditions as appropriate to meet the above goals, using the following table of *minimum recommended net conditions*. To use the table, read down the list of situations until you find a question that can be answered, “Yes.” Then, look under the appropriate watch status column to determine the net condition.

Adjacent Counties Lapeer Oakland Wayne		Net Condition (Based on Macomb County National Weather Service Watch Status)		
Item	Situation	No Watch	Severe Thunderstorm Watch	Tornado Watch
1	Are spotters reporting tornadoes, funnel clouds, or wall clouds in Macomb county?	Red	Red	Red
2	Is there a tornado warning for Macomb County?	Red	Red	Red
3	Are spotters reporting hail or damaging winds in Macomb County?	Yellow	Yellow	Yellow
4	Is there a tornado warning in an adjacent county, with the storm moving toward Macomb County?	Yellow	Yellow	Yellow
5	Is there a severe thunderstorm warning for Macomb County?	Green	Green	Yellow
6	Is MICON requesting activation in Macomb County?	Green	Green	Green
7	Is there a severe thunderstorm warning in an adjacent county, with the storm moving toward Macomb County?	Standby	Green	Green
8	Is there a thunderstorm in Macomb County?	Standby	Standby	Green
9	Is MICON requesting general activation, or activation in adjacent counties?	Standby	Standby	Standby
10	Are thunderstorm cells in adjacent counties moving toward Macomb?	Inactive	Inactive	Standby
11	All others	Inactive	Inactive	Inactive

Appendix B: Technical Resource Information

Introduction	This appendix lists frequencies and other information needed to access the technical resources listed in this guide.
Macomb County Skywarn Nets – Primary	Macomb County ARPSC repeater – WA8MAC - Mt. Clemens, MI: Output: 147.200 MHz Input: 147.800 MHz CTCSS: 100 Hz
Macomb County Skywarn Nets – Backup	USECA repeater – K8UO – Utica, MI (receive – Warren, Romeo, and Mt. Clemens, MI) Output: 147.180 MHz Input: 147.780 MHz CTCSS: 100 Hz LCARC repeater – N8LC – Sterling Heights, MI Output: 147.080 MHz Input: 147.680 MHz
MICON-DTX Liaison Nets	K1DE repeater – Milford, MI Output: 442.150 MHz Input: 447.150 MHz CTCSS: 100 Hz EchoLink Computer Application http://www.echolink.org/
MICON-DTX Packet	K8DTX – bulletin board on TNC – White Lake, MI 145.76 MHz
MICON-DTX APRS	K8DTX – White Lake, MI 144.39 MHz
Lapeer County Skywarn Nets	LCARA repeater – W8LAP – Lapeer, MI Output: 146.620 MHz Input: 146.020 MHz
Oakland County Skywarn Nets	Oakland County ARPSC repeater – W8OAK – Pontiac, MI Output: 145.250 MHz Input: 144.650 CTCSS: 100 Hz
St. Clair County Skywarn Nets	PHART Repeater – K8DD – Port Huron, MI Output: 147.300 MHz Input: 147.900 MHz
Wayne County Skywarn Nets	RADAR repeater – WR8DAR – Detroit, MI Output: 145.330 MHz Input: 144.730 CTCSS: 100 Hz
NWS Internet Forecasts, Severe Weather Outlook, and Radar	See: http://www.crh.noaa.gov/forecasts/MIZ070.php?warncounty=MIC099

**NWS Storm
Prediction Center
Forecast Products**

See:

<http://www.spc.noaa.gov/products/>

**EMWIN Satellite
and Internet Push**

See:

<http://iwin.nws.noaa.gov/emwin/index.htm>

**EMWIN FM
Subcarrier
Rebroadcast**

WGPR FM – Detroit, MI

107.5 MHz Subcarrier frequency TBD

http://www.crh.noaa.gov/emwin/cr_freqs.html

**NOAA Weather
Radio**

KEC-63 – Southfield, MI

162.55 MHz

Appendix C: Skywarn Operational Skills and Training Standard

Skill / Knowledge Area	Operational Roles				Training Courses		
	NCS Operator	MICON Key Station	EMWIN Resource	Spotter	FEMA IS2	NWS Spotter Training	Macomb Skywarn Ops Briefing
General							
The role of the spotter in assisting the NWS	M	M	M	M		M	
Macomb County Skywarn operational procedures – spotter	M	M	M	M		M	
Macomb County Skywarn operational procedures – non-spotter roles, including MICON procedures	M	M	M				M
Mitigation							
NCS design – protection from wind and lightning	M	R	R		R		M
NCS design – emergency power sources	M	R	R				M
NWS forecast / warning products – methods of dissemination	M	M	M	M		M	
NWS forecast / warning products – watch and warning definitions	M	M	M	M		M	
NWS forecast / warning products – information for advance notification (SPC products, AFD, etc.)	M	R	M	R			M
Preparedness							
Selection of amateur radio equipment for Skywarn operations	M	M	M	M		M	
Creating a Skywarn jump kit, including emergency vehicle supplies	M	M	M	M		M	
Identification of permanent fixed severe weather shelters	M	M	M	M	R	M	
Response							
Spotter safety – severe weather hazards, principles of protection and avoidance, emergency places of safety, and placement of body for maximum protection	M	M	M	M	R	M	
Spotter safety – operation of a motor vehicle during heavy rain and other severe weather elements	M	M	M	M		M	
Spotter safety – identification and avoidance of physical hazards resulting from storm damage	M	M	M	M	M		
Spotting – basic thunderstorm structure, development, and life cycle	M	M	M	M		M	
Spotting – basic thunderstorm types	M	M	M	M		M	
Spotting – tornadoes, including structure, precursors, life cycle, and variations	M	M	M	M		M	

Skill / Knowledge Area	Operational Roles				Training Courses		
	NCS Operator	MICON Key Station	EMWIN Resource	Spotter	FEMA IS2	NWS Spotter Training	Macomb Skywarn Ops Briefing
Spotting – non-tornadic severe weather elements and reporting criteria	M	M	M	M		M	
Spotting – look-alikes	M	M	M	M		M	
Spotting – nighttime spotting	M	M	M	M		M	
Reporting – methods and procedures	M	M	M	M		M	

Appendix D: Metrics Standard

Purpose

The NWS liaisons, Macomb County ARPSC officers, and served agency stakeholders utilize the following metrics to help gauge the performance and effectiveness of the Skywarn service, including:

- Whether operators are available and serve during nets (readiness)
- The amount of effort operators contribute (service)
- Whether operators adhere to procedures and standards (quality)

These metrics are indirectly used to determine whether changes should be made to the service to better address the served agency needs. Examples of changes include:

- More aggressive recruiting for Skywarn participation
- Enhancements to operator training
- Modification of radio equipment configurations
- Procedural changes

These metrics are never used to assess the effectiveness or performance of any individual.

This section outlines measurements for readiness, service, and quality.

Readiness

Readiness is measured and reported along two dimensions, general readiness and ongoing readiness, as follows:

- **General readiness** is the quantity of operators available for spotting who have received Skywarn training within the past 24 months. It is calculated by simply counting the number of operators residing within Macomb County who have attended a Skywarn training class, using the class sign-in sheets.
- **Ongoing readiness** assesses the County-wide coverage of spotters during Skywarn nets, and is calculated after every event. It is expressed as a percentage, and assumes that seven spotters in each of the three sections of the county provides complete coverage. The formula for ongoing readiness is *(event 1 readiness + event 2 readiness + ...most recent event readiness) ÷ total number of events*. Event readiness in the above formula is calculated for each event from the following:

$$\begin{aligned} & ((\text{the lesser of 1 or (number of spotters in northern section } \div 7)) + \\ & (\text{the lesser of 1 or (number of spotters in central section } \div 7)) + \\ & (\text{the lesser of 1 or (number of spotters in southern section } \div 7))) \\ & \div 3 \end{aligned}$$

If the NWS issues a tornado or severe thunderstorm warning for Macomb County and a net does not at least enter condition green within 20 minutes, an event is recorded with an event readiness of “zero.”

Service

Service is measured and reported along two dimensions, event service hours and monthly service hours, as follows:

- **Event service hours** means for any single event, the sum of all time spent on the net by all station operators. The formula for event service hours is $(station\ 1\ checkout\ time - station\ 1\ check-in\ time) + (station\ 2\ checkout\ time - station\ 2\ check-in\ time) + \dots (last\ station\ check-out\ time - last\ station\ check-in\ time)$
- **Monthly service hours** means the event service hours for all events that begin within any single month. The formula for monthly service hours is $event\ 1\ service\ hours + event\ 2\ service\ hours + \dots last\ event\ service\ hours$

Quality

Quality is measured and reported along two dimensions, event quality and average yearly quality, as follows:

- **Event quality** is a percentage that is determined by whether reports made by stations are consistent with the current net condition. For example, reports of gust front arrival during condition green and a wall cloud during condition red are consistent with the current net condition. Reports of gust front arrival during condition red are not consistent with the current net condition, nor are reports of sun shining or outdoor warning sirens sounding during any net condition. The formula for event quality is $number\ of\ reports\ consistent\ with\ net\ condition \div total\ number\ of\ reports$
- **Average yearly quality** is the running average of event quality for the year. Average yearly quality is recalculated after each event; its formula is $(event\ 1\ quality + event\ 2\ quality + \dots most\ recent\ event\ quality) \div total\ number\ of\ events$

Event quality is calculated only if a net progresses to condition green or higher; if event quality is not calculated, then the event is ignored when calculating average yearly quality.
